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P 103

AEROSPACE MEDICINE AND BIOLOGY

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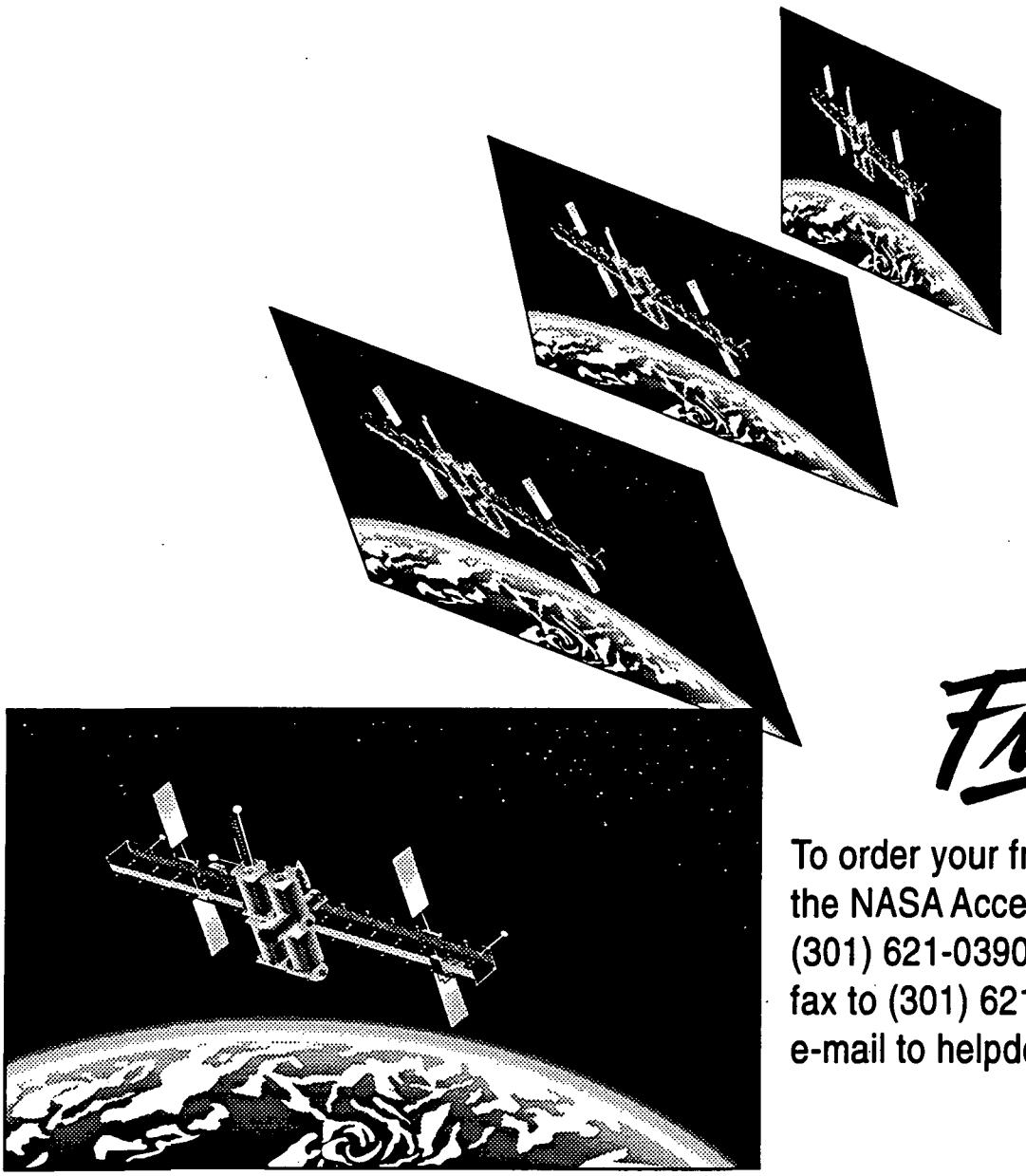

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INTRODUCTION

This issue of *Aerospace Medicine and Biology* (NASA SP-7011) lists 244 reports, articles, and other documents recently announced in the NASA STI Database. The first issue of *Aerospace Medicine and Biology* was published in July 1964.

Accession numbers cited in this issue include:

Scientific and Technical Aerospace Reports (STAR) (N-10000 Series)	N95-19883 — N95-22477
Open Literature (A-60000 Series)	A95-69894 — A95-73326

In its subject coverage, *Aerospace Medicine and Biology* concentrates on the biological, physiological, psychological, and environmental effects to which humans are subjected during and following simulated or actual flight in the Earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. Applied research receives the most emphasis, but references to fundamental studies and theoretical principles related to experimental development also qualify for inclusion.

Each entry in the publication consists of a standard bibliographic citation accompanied, in most cases, by an abstract. The listing of the entries is arranged by *STAR* categories 51 through 55, the Life Sciences division. The citations include the original accession numbers from the NASA STI Database.

Seven indexes—subject, personal author, corporate source, foreign technology, contract number, report number, and accession number—are included.

A cumulative index for 1995 will be published in early 1996.

The NASA CASI price code table, addresses of organizations, and document availability information are located at the back of this issue.

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TYPICAL REPORT CITATION AND ABSTRACT

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ACCESSION NUMBER → N95-10863*# National Aeronautics and Space Administration. ← CORPORATE SOURCE
Ames Research Center, Moffett Field, CA.
TITLE → BIOTELEMETRY IMPLANT VOLUME AND WEIGHT IN RATS: A PILOT STUDY REPORT
AUTHOR → CHRIS J. SOMPS May 1994 19 p ← PUBLICATION DATE
CONTRACT NUMBER → (Contract RTOP 545-20-01)
REPORT NUMBERS → (NASA-TM-108812; A-94059; NAS 1.15:108812) Avail: CASI HC ← AVAILABILITY AND PRICE CODE
A03/MF A01

This paper reports the results of a pilot study in which a 240-gram rat was implanted for 41 days with biotelemetry devices weighing a total of 36 gm (18 cc). The implanted animal showed no differences in weight gain, food and water consumption, and postnecropsy organ weights when compared to both an unoperated control animal and an animal that underwent surgery but did not receive an implant. The implanted animal also had temperature and activity rhythms similar to those reported using much smaller implants. Thus, this pilot study showed that a 240-gm rat could be implanted with biotelemetry devices weighing nearly 15 percent of body weight without significant changes in health or behavior. A larger study involving more animals and similar implant sizes is recommended. Author

TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT

NASA SPONSORED

ACCESSION NUMBER → A95-63745* National Aeronautics and Space Administration. John F. ← CORPORATE SOURCE
Kennedy Space Center, Cocoa Beach, FL.
TITLE → THE ORIGIN AND EARLY EVOLUTION OF ISSOL
AUTHOR → RICHARD S. YOUNG NASA. Kennedy Space Center, Cocoa Beach, ← AUTHORS' AFFILIATION
FL, US ISSOL Meeting, 7th, Barcelona, Spain, July 4-9, 1993.
PRIMARY DOCUMENT → A95-63744 Origins of Life and Evolution of the Biosphere (ISSN 0169- ← JOURNAL TITLE
6149) vol. 24, no. 2-4. June 1994 p. 83 ← PUBLICATION DATE
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This is a discussion of the beginnings of the International Society for the Study of the Origin of Life (ISSOL)—how it came to be and the people responsible for it. It will include the early meetings on the subject of the Origin of Life which led to the formation of the Society. It will discuss the genesis of the interest of NASA in such a program and how the Exobiology Program got started, leading up to the Viking Program and the early exploration of Mars. Photographs of early meetings and the scientists involved will be included. Author (Herner)

AEROSPACE MEDICINE AND BIOLOGY

A Continuing Bibliography (Suppl. 402)

June 1995

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LIFE SCIENCES (GENERAL)

A95-71475
EFFECT OF HEAT STRESS ON MUSCLE ENERGY METABOLISM DURING EXERCISE

M. A. FEBBRAIO Victoria Univ. of Technology, Footscray, Australia, R. J. SNOW Victoria Univ. of Technology, Footscray, Australia, C. G. STATHIS Victoria Univ. of Technology, Footscray, Australia, M. HARGREAVES Victoria Univ. of Technology, Footscray, Australia, and M. F. CAREY Victoria Univ. of Technology, Footscray, Australia
Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2827-2831
(HTN-95-70453) Copyright

To examine the effect of heat stress on muscle energy metabolism during submaximal exercise, 12 endurance-trained men cycled on two occasions for approximately 40 min at 70% maximal O2 uptake in an environmental chamber at either 20 C and 20% relative humidity T(sub 20) or 40 C and 20% relative humidity T(sub 40). Trials were conducted equal to or greater than 1 wk apart in random order. No difference in mean O2 uptake was observed when exercise in T(sub 40) was compared with that in T(sub 20). In contrast, exercise in T(sub 40) resulted in a higher mean heart rate and respiratory exchange ratio compared with that in T(sub 20). Postexercise rectal and muscle temperatures were also higher in T(sub 40) than in T(sub 20). Lower postexercise creatine phosphate and higher creatine and ammonia were observed in muscle after exercise in T(sub 40) compared with T(sub 20). In addition, an increased muscle glycogenolysis and higher postexercise muscle lactate accumulation were observed during exercise in T(sub 40) compared with T(sub 20). In contrast, no differences were observed in postexercise concentrations of total adenine nucleotide pool (ATP + ADP + AMP), ATP/ADP ratio or inosine 5'-monophosphate (IMP) when T(sub 40) was compared with T(sub 20). These results indicate that the rate of ATP utilization may be increased during exercise in the heat but that this increased energy demand is predominantly met by an increase in anaerobic glycolysis and creatine phosphate hydrolysis, preventing a reduction in total adenine nucleotide pool. In addition, the higher postexercise concentration of muscle ammonia observed in T(sub 40), in the absence of any differences in muscle IMP accumulation, suggests that ammonia is produced by sources other than net adenine nucleotide degradation. Author (Herner)

A95-71476
EFFECT OF ACCLIMATIZATION TO HIGH ALTITUDE (5,050 M) ON MOTOR UNIT ACTIVATION PATTERN AND MUSCLE PERFORMANCE

CLAUDIO ORIZIO Univ. di Brescia, Brescia, Italy, FABIO ESPOSITO Univ. di Brescia, Brescia, Italy, and ARSENIO VEICSTEINAS Univ. di Brescia, Brescia, Italy
Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2840-2844 Research sponsored by Comitato and Ministero dell' Universita e della Ricerca Scientifica e Tecnologica
(HTN-95-70454) Copyright

This study evaluated the influence of acute and chronic hypoxia (up to 40 days at 5,050 m) on the muscle strength, fast-to-slow fiber motor unit (MU) ratio, and MU activation strategy. These factors were studied by measuring the maximal voluntary contraction (MVC) of the elbow flexors and analyzing surface electromyogram (EMG) and soundmyogram (SMG) of the isometrically contracting biceps brachii. From the time and frequency domain analysis of EMG and SMG, the root mean square and mean frequency of the spectra were calculated. SMG and EMG were recorded during 4-s exercises in the 20-100% MVC range before departure; after 2, 15, and 40 days at high altitude; and after the return to sea level. MVC or root mean square and mean frequency at all levels of effort were not significantly different among all experimental conditions. In the present study where optimal living conditions (i.e., food, physical activity, and environmental temperature) were ensured, acute and chronic hypoxia (at least up to 40 days) did not affect the maximal force output or fast-to-slow fiber MU ratio and MU activation pattern during isometric exercise. Author (Herner)

A95-71477
ENHANCED ADIPOSE TISSUE LIPOPROTEIN LIPASE ACTIVITY IN DETRAINED RATES: INDEPENDENT OF CHANGES IN FOOD INTAKE

ESTELLE V. LAMBERT, GRAHAM WOODING, MICHAEL I. LAMBERT, JOHAN H. KOESLAG, and TIMOTHY D. NOAKES
Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2564-2571 Research sponsored by the Medical Research Council of South Africa, the Nellie Atkinson and Harry Crossley Research Funds and the South African Sugar Association
(HTN-95-70455) Copyright

Short-term detraining has been characterized by increased body mass and rapid body fat accretion. However, detraining has also been associated with increased food intake, especially in rats genetically predisposed to obesity. Thus, it has been difficult to separate refeeding effects from alterations resulting from the cessation of exercise training. In the present study, the in vitro activity of adipose tissue lipoprotein lipase (ATLPL) was measured in freely running wheel-trained rats and rats that had stopped training for 1, 2, or 3 days or 1 or 2 wk, respectively. Heparin-releasable ATLPL activity was measured at rest and after acute exhaustive exercise. Feeding efficiency (change in body mass/kJ ingested energy), fat pad mass, and adipocyte size were also measured. The rate of weight gain in 1- and 2-wk detrained rats was significantly higher than that of sedentary control or trained rats. Feeding efficiency was also higher in 1-wk detrained rats than in all other groups. However, food energy intake was not different between trained rats, 1 -and 2-wk detrained rats, or sedentary control rats. ATLPL activity in all groups was highest after acute exhaustive exercise. ATLPL activity in 1-wk detrained rats was nearly threefold higher compared with that in trained rats and was not different from that of sedentary control rats. These results suggest that the cessation of exercise training causes an enhanced capacity for lipogenesis independent of changes in food energy intake or the acute effects of the last bout of exercise. Author (Herner)

A95-71478
CARDIORESPIRATORY KINETICS AND FEMORAL ARTERY BLOOD VELOCITY DURING DYNAMIC KNEE EXTENSION EXERCISE
J. K. SHOEMAKER Univ. of Waterloo, Waterloo, Ontario, Canada, L. HODGE Univ. of Waterloo, Waterloo, Ontario, Canada, and R. L. HUGHSON Univ. of Waterloo, Waterloo, Ontario, Canada
Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2625-2632 Research sponsored by NSERC (HTN-95-70456) Copyright

The kinetcis of femoral artery mean blood velocity (MBV; measured by pulsed Doppler) and whole body oxygen uptake (dot-VO2; measured breath by breath) were assessed from the time constant during the on (tau(sub on)) and off (tau(sub off)) transients to step changes in work rate between complete rest and dynamic knee extension (KE) exercise. Six healthy men performed 5 min of seated KE exercise, with each leg alternately raising and lowering a weight (10% maximum voluntary contraction) over a 2-s duty cycle. Because kinetic analysis of dot-VO2 kinetics during KE exercise is a new approach, the dot-VO2 responses were also evaluated during the on and off transitions to the more familiar upright cycling exercise in which the magnitude of increase in dot-VO2 and cardiac output was similar to that during KE exercise. During KE exercise, dot-VO 2 tau(sub on) was slower than dot-VO2 tau(sub off). Caridac output, measured with impendance cardiography, was not different for tau(sub on) compared with that for tau(sub off). Likewise, MBV tau(sub on) was not different from tau(sub off). During cycling, the dot-VO2 tau(sub on) and tau(sub off) were both faster than KE dot-VO2 tau(sub on). Even though the MBV kinetics indicated a rapid adaptation of blood flow during KE exercise, there was a slow adaptation of dot-VO2. A transient hyperemia immediately on cessation of KE exercise, indicated by both MBV and calculated systemic vascular conductance responses, suggested that blood flow might have been inadequate and could have contributed to the delayed adaptation of dot-VO2 at the onset of exercise, although other explanations are possible. Author (Hemer)

A95-71479
TRAINING-RELATED ENHANCEMENT IN THE CONTROL OF MOTOR OUTPUT IN ELDERLY HUMANS
DOUGLAS A. KEEN Univ. of Arizona, Tucson, AZ, US, GUANG H. YUE Univ. of Arizona, Tucson, AZ, US, and ROGER M. ENOKA Univ. of Arizona, Tucson, AZ, US
Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2648-2658 (Contract(s)/Grant(s): NIH-AG-09000) (HTN-95-70457) Copyright

The increase in motor unit force that occurs with aging has been hypothesized to cause a decline in the ability to maintain a constant submaximal force. To test this hypothesis, young and elderly subjects performed a 12-wk strength-training program that was intended to increase motor unit force. The training program caused similar increases (% initial) in the training load, twitch force, and maximum voluntary contraction force of the first dorsal interosseus muscle for the young and elderly subjects. The increase in strength was associated with a modest increase in muscle volume (7% of initial value) and a nonmonotonic increase in the surface-recorded electromyogram that was significant at week 8 but not at week 12. The elderly subjects reduced the variability in force at the lower target forces (2.5, 5.0, and 20.0% maximum voluntary contraction force). This improvement, however, was unrelated to changes in the distribution of motor unit forces, which was not consistent with the hypothesis that the greater coefficient of variation for the force fluctuations is due to increased motor unit forces. Author (Hemer)

A95-71480
EVALUATION OF A SYMMETRICALLY DISPOSED PITOT TUBE FLOWMETER FOR MEASURING GAS FLOW DURING EXERCISE
JANOS PORSZASZ Univ. of California at L. A. Harbor Medical Center, Torrance, CA, US, THOMAS J. BARSTOW Univ. of California at L. A. Harbor Medical Center, Torrance, CA, US, and KARLMAN WASSERMAN Univ. of California at L. A. Harbor Medical Center, Torrance, CA, US
Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2659-2665 (HTN-95-70458) Copyright

We evaluated the effect of airflow and gas composition on the linearity of measurement of airflow by a new disposable flowmeter. The flowmeter is based on the principle of differential pressure measurement across two symmetrically disposed Pitot tubes. Nonlinearities arising from the pressure-to-airflow relationship and sensitivity to changes in gas density were linearized with appropriate software and monitoring of the gas composition. With room air used as the respired gas, the measured tidal volume from a piston pump assembly was consistently within 1-2% of the target tidal volume for each of five flowmeters tested across physiological ranges of flow. Changing gas densities by varying concentrations of O2, CO2, and N2 led to errors in tidal volume measurement that ranged up to 6-8%. However, because the errors were predictable, they were corrected by software to within 0.6% of the target volume. Measurement of minute ventilation during exercise was within 1-2% of that determined from bag collections. We conclude that this type of flowmeter can accurately measure exercise minute ventilation and has advantages over some other flowmeters because of its ruggedness, reproducibility, and ease of sterilization or replacement compared with other flowmeters. Author (Hemer)

A95-71481
MUSCLE CHEMOREFLEX ALTERS VASCULAR CONDUCTANCE IN NONISCHEMIC EXERCISING SKELETAL MUSCLE
SCOTT W. MITTELSTADT Medical College of Wisconsin, Milwaukee, WI, US, LEONARD B. BELL Medical College of Wisconsin, Milwaukee, WI, US, KATHLEEN P. O'HAGAN Medical College of Wisconsin, Milwaukee, WI, US, and PHILIP S. CLIFFORD Medical College of Wisconsin, Milwaukee, WI, US
Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2761-2766 Research sponsored by the Dept. of Veterans Affairs, Medical Research Service (Contract(s)/Grant(s): NIH-HL-39712) (HTN-95-70459) Copyright

Previous studies have shown that the muscle chemoreflex causes an an augmented blood pressure response to exercise and partially restores blood flow to ischemic muscle. The purpose of this study was to investigate the effects of the muscle chemoreflex on blood flow to nonischemic exercising skeletal muscle. During each experiment, dogs ran at 10 kph for 8-16 min and the muscle chemoreflex was evoked by reducing hindlimb blood flow at 4-min intervals (0-80%). Arterial blood pressure, hindlimb blood flow, forelimb blood flow, and forelimb vascular conductance were averaged over the last minute at each level of occlusion. Stimulation of the muscle chemoreflex caused increases in arterial blood pressure and forelimb blood flow and decreases in forelimb vascular conductance. The decrease in forelimb vascular conductance demonstrates that the muscle chemoreflex causes vasoconstriction in the nonischeme exercising forelimb. Despite the decrease in vascular conductance, the increased driving pressure caused by the pressor response was large enough to produce an increased forelimb blood flow. Author (Hemer)

A95-71482
RECOVERY OF MEDIAL GASTROCNEMIUS MUSCLE GRAFTS IN RATS: IMPLICATIONS FOR THE PLANTAR FLEXOR GROUP
STEPHANIE W. MILLER, CHERYL A. HASSETT, TIMOTHY P. WHITE, and JOHN A. FAULKNER
Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2773-2777. (Contract(s)/Grant(s): NIH-DE-07687; NIH-AG-00114) (HTN-95-70460) Copyright

Medical gastrocnemius (MGN) muscles were grafted in 18 rats and evaluated at 60, 90, and 120 days after the operation. Our purpose was to investigate the degree of recovery of the vascularized MGN grafts and the entire plantar flexor muscle group. Compared

with control values, muscle mass and maximum force of MGN grafts were decreased by 33 and 38% at 60 days, 22 and 32% at 90 days, and 13 and 15% at 120 days. At 60 and 90 days, the deficits in maximum force for the entire plantar flexor muscle group, including the graft, were 29 and 17%, respectively. No difference was observed at 120 days. At 60 days, the deficit in the total mass of the plantar flexor group was 14% compared with control values, but by 90 days no deficit was observed. The restoration of normal plantar flexor group structure and function indicates that the degree of recovery attained by MGN grafts, although not complete, was sufficient to ensure that the performance of the total muscle group was not compromised. Author (Hemer)

A95-71483
EXERCISE, POTASSIUM, AND MUSCLE DECONDITIONING POST-THORACIC ORGAN TRANSPLANTATION

MICHAEL J. HALL Alfred Hospital, Melbourne, Australia, GREG I. SNELL Alfred Hospital, Melbourne, Australia, ELEONORA A. SIDE Alfred Hospital, Melbourne, Australia, DONALD S. ESMORE Alfred Hospital, Melbourne, Australia, E. HAYDN WALTERS Alfred Hospital, Melbourne, Australia, and TREVOR J. WILLIAMS Alfred Hospital, Melbourne, Australia Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2784-2790 Research sponsored by a Dept. of Respiratory Medicine Research Scholarship
(HTN-95-70461)

Although muscle deconditioning appears to significantly limit peak exercise performance post-thoracic organ transplantation, few confirmatory data exist. Potassium, K(+), regulation during exercise may reflect muscle deconditioning, since both peak plasma K(+) concentration (K(+)) and the increase in plasma (K(+)) relative to energy expenditure (delta (K(+))/W) are reduced in healthy individuals after training. This study compares delta (K(+))/W during graded exercise and the change in (K(+)) delta (K(+)) during both exercise and recovery in 12 heart transplant (HT) recipients, 14 lung transplant (LT) recipients, and 7 healthy subjects. Plasma (K(+)) was determined from arterial blood sampled at rest; during the final 15 s of each power output; and at 1, 2, and 5 min postexercise. Peak oxygen consumption was significantly lower, whereas delta (K(+))/W was significantly higher among the HT and LT groups. When delta (K(+)) during recovery was expressed relative to delta (K(+)) detected during activity, no difference at 1, 2, or 5 min postexercise was detected, although the absolute fall in plasma (K(+)) was greater among the healthy subjects in the 1st min. The rate of delta (K(+)) during recovery appears to reflect the rise seen during activity in all groups. These results suggest that (K(+)) regulation is altered during exercise in both HT and LT recipients and may reflect muscles deconditioning. Author (Hemer)

A95-71484
CA(2+) AND LIPOLYSIS IN ADIPOCYTES FROM EXERCISE-TRAINED RATS

TETSUYA IZAWA and TAKAO KOMABAYASHI Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2618-2624 Research sponsored by the Ministry of Education, Science and Culture of Japan
(HTN-95-70462)

The effects of Ca(2+) on lipolysis and protein kinase activity in adipocytes from exercise-trained rats were investigated. Chronic exercise significantly increased lipolytic responses to norepinephrine and dibutyryl adenosine 3',5'-cyclic monophosphate (cAMP). The inhibitory effects of N-(6-aminohexyl) 5-chloro-1-naphthalene sulfonamide (W-7), a calumodulin inhibitor, on norepinephrine- and dibutyryl cAMP -stimulated lipolysis were significantly greater in trained than in sedentary rats. Training did not alter cAMP -dependent protein kinase activity. However, the inhibitory effect of W-7 on cAMP -dependent protein kinase activity was much greater in trained than in sedentary rats. The basel intracellular free Ca(2+) concentration (Ca(2+)(sub i)) was significantly higher in trained than in sedentary rats. The rapid and transient increases in Ca(2+)(sub i) due to adrenocorticotropic hormone and phenylephrine from basal levels were significantly lower in trained than in sedentary rats. However, the higher basel Ca(2+)(sub i) level in trained rats led to increases in sustained Ca(2+)(sub i) levels after stimulation. We concluded that in trained rats the regulation of protein kinase activity by cAMP depends to a greater degree on Ca(2+)-calmodulin complex than it does in sedentary rats and that training alters adipocyte intracellular Ca(2+) homeostasis, including Ca(2+)(sub i) responsiveness to hormones. Author (Hemer)

A95-71485
PRELOAD RELEASE INCREASES BLOOD FLOW AND DECREASES FATIGUE DURING REPETITIVE ISOTONIC MUSCLES CONTRACTIONS

BILL T. AMEREDES, WILLIAM F. BRECHUE, and WENDELL N. STAINSBY Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2641-2647
(Contract(s)/Grant(s): NIH-AR-39378)
(HTN-95-70463)

The effecs of preload on blood flow (dot-Q), O2 uptake (dot-VO2), and fatigue were investigated in the canine gastrocnemius-plantaris muscle in situ. Repetitive (1 contraction/s, 200 ms duration) afterloaded (0.25-0.3 maximal activity isometric tension) isotonic tetanic contractions were performed in high-preload, low-preload, and preload-release experiments. Maximal dot-Q values and O2 delivery increased significantly with decreasing preload. The maximal dot-VO2 of HP was 7.2 micro mol/min/g, which is significantly lower than both LP and PR values; these differences were sustained through 20 min of contractions. Fatigue, measured as a loss of power production, was 63, 37, and 23% at 20 min of contractions in HP, LP, and PR, respectively, indicating significantly less fatigue with decreasing preload. These data demonstrate that the preload, present as the level of passive tension maintained between contractions, can influence dot-Q, dot-VO2, and fatigue during repetitive isotonic tetanic contractions of muscle in situ by a mechanically determined metabolic modulation of dynamic muscle performance. Author (Hemer)

A95-71486
SYMPATHETIC AND PARASYMPATHETIC INDICATORS OF HEART RATE CONTROL AT ALTITUDE STUDIED BY SPECTRAL ANALYSIS

R. L. HUGHSON, Y. YAMAMOTO, R. E. MCCULLOUGH, J. R. SUTTON, and J. T. REEVES Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2537-2542 Research sponsored by NSERC and the Heart and Stroke Foundation of Ontario
(Contract(s)/Grant(s): DAMD-17-91-C-1112; NIH-HL-14985; NIH-HL-46481)
(HTN-95-70464)

The adaptive responses of the cardiovascular system to altitude appear to be dominated by increased sympathetic neutral activity. We investigated the combined roles of the sympathetic and parasympathetic nervous systems (SNS and PNS, respectively) in the early (days 4-5) and subsequent (days 11-12) phases of acclimatization on Pike's Peak, CO (4,300 m), by spectral analysis of heart rate variability. Male subjects were randomly assigned to groups receiving oral propranolol (240 mg/day; n = 6) or a matched placebo (*n* = 3). On ascent to altitude, the high-frequency, fractal, and total spectral powers were reduced in the placebo group during days 4-5 and 11-12. At altitude during days 4-5, all three placebo groups subjects increased SNS and decreased PNS activities compared with at sea level, and during days 11-12 SNS decreased and PNS increased compared with days 4-5. Relative to the placebo group, propranolol caused lengthening of the R-R interval; increases in high-frequency power, total spectral power, and the PNS indicator; and a decrease in the SNS indicator. Total spectral power tended to decrease at altitude, but there were no effects of altitude on PNS and SNS indicators in the propranolol group. The data from the placebo and propranolol groups suggest that both the PNS and SNS are involved in the elevated heart rate during the early phase of altitude acclimatization. Changes in heart rate variability during days

11-12 at altitude must be considered in light of the possible reductions in sympathetic receptor number noted in previuos studies.
Author (Herner)

A95-71487
CISTERNAL NA(+) TRANSPORT INHIBITION AND THE VENTILATORY RESPONSE TO CO2
MARYROSE P. SULLIVAN Univ. of Virginia, Charlottesville, VA, US and J. MILTON ADAMS Univ. of Virginia, Charlottesville, VA, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2572-2577
(Contract(s)/Grant(s): NIH-HL-29396; NIH-GM-07593; NIH-HL-01196)
(HTN-95-70465)

When P(sub CO2) rises transiently, glia or neurons may move ions across their cell membranes to restore many ions across their cell membranes to restore intracellular pH, in the process changing extracellular pH. Inhibiting ion transport would result in a different extracellular fluid pH (a putative stimulus for the medullary chemoreceptors) and, therefore, in an altered ventilation in response to P(sub CO2). We infused two ion transport inhibitors, amiloride and bumetanide, into the cisterna magna of anesthetized rabbits and compared their ventilatory response to a rebreathing maneuver with sham rabbits receiving no inhibitor. Amiloride had no effect; 3 h of 10(exp -2) M amiloride increased the frequency of breathing and decreased tidal volume but had no net effect on minute ventilation. Bumetanide had no effect after 1 h of infusion, but by 3 h it had decreased tidal volume and minute ventilation at 6 and 7% end-tidal CO2 fraction, respectively, during the rebreathe. Three hours of infusion of amiloride and bumetanide did not affect ventilation in a manner consistent with our predictions from previous studies of ionic changes in cerebrospinal fluid. During the 1st h, when neuronal and glial ion transport in the ventrolateral medulla should be inhibited, we found no effect of ion transport inhibition. We conclude that, during the transient hypercapnia of a rebreathing maneuver NA(+)/H(+) exchange and Na(+)-K(+)-2Cl(-) cotransport do not play a significant role in immediate rapid pH homeostasis by cellular ion transport in the microenvironment of the medullary chemoreceptors.
Author (Herner)

A95-71488
SOFT PALATE MUSCLE ACTIVITY IN RESPONSE TO HYPOXIC HYPERCAPNIA
T. VAN DER TOUW Westmead Hospital, Westmead, New S. Wales, Australia, N. O'NEILL Westmead Hospital, Westmead, New S. Wales, Australia, T. AMIS Westmead Hospital, Westmead, New S. Wales, Australia, J. WHEATLEY Westmead Hospital, Westmead, New S. Wales, Australia, and A. BRANCATISANO Westmead Hospital, Westmead, New S. Wales, Australia Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2600-2605 Research sponsored by the National Health and Medical Research Council of Australia and the Community Health and Anti-Tuberculosis Association of New South Wales, Australia
(HTN-95-70466)

We studied the effects of increasing respiratory drive on electomyographic (EMG) soft palate muscle (SPM) activity in nine anesthetized tracheostomy-breathing dogs during hypoxic hypercapnia (HH) with a 14% O2-8% CO2-78% N2 inspired gas mixture. Moving time average EMG activity was recorded from palatinus (PAL), levator veli palatini (LP), and tensor veli palatini (TP) muscles (with bipolar fine-wire electrodes) and diaphragm (DIA; with bipolar hook electrodes). During HH, peak inspiratory DIA activity increased from 18.8 +/- 1.3 to 30.1 +/- 2.0 arbitrary units and minute ventilation increased from 6.2 +/- 0.3 to 18.3 +/- 1.8 l/min. Phasic inspiratory, expiratory, and/or tonic EMG activity was present in each SPM during room air breathing (control) and increased during HH, except for phasic inspiratory PAL and phasic expiratory TP activites. Peak inspiratory LP and TP activities increased during HH to 250 and 179% of control, respectively, and peak expiratory activites increased to 187, 235, and 181% of control in PAL, LP, and TP, respectively. These finding demonstrate respiratory-related regulation of SPM activity independent of local reflex control from the upper airway. However, the combined inspiratory and expiratory phasic recruitment of these muscles differs from the inspiratory recruitment of known upper airway dilator muscles. Author (Herner)

A95-71489
EFFECT OF NA(+) AND K(+) CHANNEL BLOCKADE ON BASELINE AND ANOXIA-INDUCED CATECHOLAMINE RELEASE FROM RAT CAROTID BODY
THOMAS P. DOYLE Yale Univ. School of Medicine, New Haven, CT, US and DAVID F. DONNELLY Yale Univ. School of Medicine, New Haven, CT, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2606-2611
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(HTN-95-70467)

Ionic membrane currents are hypothesized to play a major role in determining secretion from carotid body glomus cells, and increased secretion likely mediates the increase in nerve activity in response to hypoxia. The hypothesis that Na(+) and K(+) channels play an important role in determining secretion and nerve activity was tested by measuring single-fiber afferent nerve activity along with an estimate of free tissue catecholamine using Nafion-covered carbon-fiber microelectrodes placed in rat carotid bodies in vitro. Baseline and anoxia-stimulated levels were quantified. Sham treatment had no significant effect. Tetrodotoxin ablated the nerve activity and reduced peak catecholamine. Cesium had no effect on catecholamine but reduced the nerve response. 4-Aminopyridine (4 mM) significantly reduced the nerve response and increased the baseline and reduced the peak catecholamine levels. These results demonstrate that Na(+) and K(+) channels play an important role in modulating the secretory and nerve responses. However, channel blockers do not emulate severe hypoxia, suggesting that hypoxia transduction procedes, at least in part, through an alternate pathway.
Author (Herner)

A95-71490
FOREARM COMPRESSION DURING EXERCISE INCREASES SYMPATHETIC NERVE TRAFFIC
JOSEPH MCCLAIN Pennsylvania State Univ., Hershey, PA, US, J. CULLEN HARDY Pennsylvania State Univ., Hershey, PA, US, and LAWRENCE I. SINOWAY Pennsylvania State Univ., Hershey, PA, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2612-2617
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(HTN-95-70468)

Previously, we showed that forearm venous congestion augmented muscle sympathetic nerve activity (MSNA) during static exercise. We postulated that venous congestion increased interstitial pressure, sensitizing mechanoreceptor afferents that led to a greater sympathoexcitation during exercise. In this study, we tested the hypothesis that forearm compression (FC) would increase interstitial pressure and selectively stimulate mechanically sensitive afferents. We measured MSNA during 2 min of ischemic static exercise (40% maximal voluntary contraction) and 2 min of posthandgrip circulatory arrest. Exercise was performed again after 5 min of FC induced by inflation of a forearm cuff to 90 mmHg (n = 6) and 110 mmHg (n = 7). FC without exercise had no effect on any of the hemodynamic variables. MSNA and mean arterial blood pressure responses were not augumented when exercise was performed with FC at 90 mmHg. However, static exercise coupled with FC at 110 mmHg did augument the reflex responses to static exercise. These responses were probably not due to greater metaboreceptor simulation since posthandgrip circulatory arrest responses were unaffected by FC. We postulate that FC sensitizes mechanoreceptors, leading to greater sympathoexcitation during exercise.
Author (Herner)

A95-71491
DOSE DEPENDENCY OF PERCEIVED BREATHLESSNESS ON HYPOVENTILATION DURING EXERCISE IN NORMAL SUBJECTS
HELEN R. HARTY Westminster Medical School, London, UK and LEWIS ADAMS Westminster Medical School, London, UK Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December

1994 p. 2666-2674 Research sponsored by Wellcome Trust (HTN-95-70469) Copyright

To determine whether a dose-dependent relationship exist between the subjective sensation of breathlessness and hypoventilation during steady-state exercise, we measured breathlessness at six levels of volitionally suppressed ventilation. To achieve this, subjects targeted their breathing at 0, 5, 10, 15, 20, and 25% below their spontaneous exercise level. All 12 subjects were successful in hypoventilating in a graded manner. However, in general, the degree of hypoventilation achieved was less than that of the target level set; this discrepancy was greatest at the higher target levels. Volitional hypoventilation at target levels of equal to or greater than 10% caused significant decreases in ventilation and significant increases in end-tidal P(sub CO2). All levels of volitional hypoventilation caused increased ratings of breathlessness, reaching statistical significance at a set target level of 15%. Significant increases in breathlessness intensity were associated with increased in end-tidal P(sub CO2) of 2-3 Torr. We conclude that, during steady-state exercise, there appears to be a dose-dependent relationship between breathlessness and volitionally induced inappropriately low ventilation. The need to minimize such subjective sensations of breathlessness may play a role in the increased ventilation observed during exercise. Author (Herner)

A95-71492

HYPOXIC INHIBITION OF BREATHING IN FETAL SHEEP: RELATIONSHIP TO BRAIN ADENOSINE CONCENTRATIONS

BRIAN J. KOOS Univ. of California, Los Angeles, CA, US, BRIAN A. MASON Univ. of California, Los Angeles, CA, US, OSCAR PUNLA Univ. of California, Los Angeles, CA, US, and ANTHONY M. ADINOLFI Univ. of California, Los Angeles, CA, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2734-2739
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Because hypoxic inhibition of fetal breathing may be caused by a rise in central adenosine levels, the effects of O2 deficiency on fetal brain adenosine concentrations were determined at levels of hypoxia that inhibited fetal breathing. Under halothane anesthesia, the brains of fetal sheep (0.8 term) were implanted with guide cannulas exteriorized through a Silastic rubber window in the uterus and flank of the ewe. At least 4 days after surgery, a microdialysis probe was inserted into a cannula with the membrane tip placed in the rostral brain stem. During 1 h of isocapnic hypoxia, mean fetal arterial P(sub O2) was reduced from 24.0 +/- 0.9 Torr (control) to 13 +/- 0.6 Torr and arterial pH fell progressively from 7.354 +/- 0.007 to 7.273 +/- 0.023. Hypoxia decreased the incidence of fetal breathing movements from 33 +/- 5.2 to 5 +/- 2.2 min/h, with a normal incidence (29 +/- 3.5 min/h) during the hour after arterial P(sub 02) returned to control values. Adenosine concentrations in microdialysis perfusate under control conditions averaged approximately 35 nM, increased up to 2.3-fold during the hour of O2 deficiency, and fell toward control values when normoxia was restored. We conclude that fetal brain adenosine levels are increased at levels of O2 deficiency that inhibit fetal breathing, which are results consistent with a role for adenosine in hypoxia inhibition of fetal breathing. Author (Herner)

A95-71493

HAMSTERS VS. RATS: METABOLIC AND VENTILATORY RESPONSE TO DEVELOPMENT IN CHRONIC HYPOXIA

P. B. FRAPPELL McGill University, Montreal, Quebec, Canada and J. P. MORTOLA McGill University, Montreal, Quebec, Canada Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2748-2752 Research sponsored by the Medical Research Council, Canada
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The post-natal developments of the rat and hamster were compared after the animals were raised from birth for 21 days either in normoxia (control animals) or chronic hypoxia (P(sub O2) of 80-90 Torr). Compared with control rats, hypoxia rats had a reduction in body mass. Hypoxic rats had lowered O2 consumption (dot-VO2) and increased (67%) ventilation (dot-VE), whereas hypoxic hamsters maintained the same metabolic rate as control hamsters but increased dot-VE by 100%. As a result, when raised in hypoxia both species increased dot-VE/dot-VO2 to the same extent. When acutely exposed to hypoxia, control animals of both species increased dot-VE (54-58%) and lowered dot-VO2 (26%). Thus, whether the exposure to hypoxia is acute or chronic, both species hyperventilated (i.e., increased dot-VE/dot-VO2) to approximately the same degree. However, in the rat dot-VO2 decreased similarly in both acute and chronic hypoxia, whereas in the hamster dot-VO2 decreased with acute hypoxia but was maintained under chronic hypoxia. Within 1 day of the animals being returned to normoxia, metabolic and ventilatory parameters of hypoxic animals returned to control values. In conclusion, the semifossorial hamster seems better suited to development in chronic hypoxia than the surface-dwelling rat because by avoiding prolonged hypometabolism it can better maintain body growth. Author (Herner)

A95-71494

ENHANCEMENT OF PARASYMPATHETIC CARDIAC ACTIVITY DURING ACTIVATION OF MUSCLE METABOREFLEX IN HUMANS

TAKESHI NISHIYASU Yamaguchi Univ., Yamaguchi, Japan, NOBUSUKE TAN Yamaguchi Univ., Yamaguchi, Japan, KEIKO MORIMOTO Yamaguchi Univ., Yamaguchi, Japan, MIYAKO NISHIYASU Yamaguchi Univ., Yamaguchi, Japan, YUKIO YAMAGUCHI Yamaguchi Univ., Yamaguchi, Japan, and NAOTOSHI MURAKAMI Yamaguchi Univ., Yamaguchi, Japan Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2778-2783 Research sponsored by the Ministry of Education, Science and Culture of Japan and the Uehara Memorial Foundation
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We measured the changes in heart rate (HR) variability estimated from the standard deviation of the R-R intervals to evaluate cardiac parasympathetic tone noninvasively before and during activation of muscle metaboreflex induced by postexercise muscle ischemia. Eight healthy male subjects performed sustained handgrip at 50% maximal voluntary contraction followed by forearm occlusion. Mean arterial pressure, cardiac stroke volume, and ratio of cardiac preejection period to left ventricular ejection time (PEP/LVET) were also measured. During the 2-min occlusion after 60 s handgrip with voluntary respiration, HR variability and mean arterial pressure were significantly increased from baseline and PEP/LVET was decreased from resting level. During occlusion and recovery, HR did not change from baseline level in any experiment. There was no influence of occlusion itself or of cessation of exercise per se on any parameters. Although overall enhanced HR variability was seen, probably due to lower breathing frequency and larger tidal volume, similar results were also obtained froman experiment with controlled respiration, showing that the increase in HR variability was not due to the changes in tidal volume or breathing frequency during occlusion. In conclusion, the HR variability is increased during activation of the muscle metaboreflex induced by postexercise muscle ischemia in humans. This finding shows that the parasympathetic cardiac tone is enhanced during enhanced cardiac sympathetic activity to result in an unchanged HR. Thus, using gross HR to determine cardiac autonomic effects may be deceptive.
Author (Herner)

A95-71495

EFFECT OF HYPERCAPNIA ON LARYNGEAL AIRWAY RESISTANCE IN NORMAL ADULT HUMANS

SAMUEL T. KUNA Univ. of Texas Medical Branch, Galveston, TX, US, CHRISTI R. VANOYE Univ. of Texas Medical Branch, Galveston, TX, US, JOHN R. GRIFFIN Univ. of Texas Medical Branch, Galveston, TX, US, and JOHN D. UPDEGROVE Univ. of Texas Medical Branch, Galveston, TX, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994

p. 2797-2803 Research sponsored by the Moody Foundation (Contract(s)/Grant(s): NIH-HL-27520; NIH-HL-02353) (HTN-95-70473) Copyright

Laryngeal airway resistance (Rlar) was measured in eight normal adult humans during progressive hyperoxic hypercapnia. In most subjects, the translaryngeal pressure-flow relationship appeared linear under normocapnic conditions. During hypercapnia, the pressure-flow relationship on inspiration and expiration was curvilinear with increasing translaryngeal pressure associated with progressively smaller increments in flow. Translaryngeal pressure-flow relationships at different CO2 levels were compared over their common flow ranges by performing at least-squares linear regression on data throughout inspiration and expiration. During normocapnia, the mean slope, i.e., mean Rlar, was 0.50 +/- 0.21 (SD) cmH2O/l/s. A moderately significant decrease in Rlar was present at 9% end-tidal CO2 (P = 0.08). In a separate series of experiments, subjects breathed oxygen- and helium-based gas mixtures through a face mask attached to a pneumotachograph. Data analysis over the flow range present during normocapnia revealed no difference in Rlar between nose and mouth breathing and similar decreases in Rlar under hypercapnic conditions with the oxygen- and helium-based gas mixtures. The decrease in Rlar from normocapnic to hypercapnic conditions found over common, but relatively low, ranges of flow predicts that even greater increases in Rlar would occur at high flow rates in the absence of increasing glottic aperture. Author (Hemer)

A95-71496
CEREBRAL HEMODYNAMICS DURING SENSORIMOTOR ACTIVATION IN HUMANS

MATTHIAS SITZER Heinrich-Heine Univ., Dusseldorf, Germany, UWE KNORR Heinrich-Heine Univ., Dusseldorf, Germany, and RUDIGER J. SEITZ Heinrich-Heine Univ., Dusseldorf, Germany
Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2804-2811 Research sponsored by DFG (HTN-95-70474) Copyright

We studied the time course and magnitude of cerebral blood flow velocity (CBFV) changes in the middle cerebral artery (MCA) and the regional cerebral blood flow (rCBF) in the MCA terriory during stimulation of the left sensorimotor cortex. Healthy right-handed male subjects were examined during performance of right-hand finger movement sequences, vibratory stimulation, and somatosensory discrimination. In somatosensory discrimination there were significant increases of the mean CBFV and the mean rCBF, whereas no significant changes of the mean CBFV and rCBF occurred in finger movement sequences or vibratory stimulation. During all stimulation sessions the mean CBFV changes increased rapidly and reached a first maximum 3.3 +/- 0.3 s after stimulation onset. Simultaneous measurements of relative mean CBFV changes in both MCAs revealed left-right differences during voluntary finger movement sequences corresponding to a higher mean rCBF change in the left MCA territory. In the two tasks involving finger movements there was an increase of the respiratory rates and the pulse rates, respectively. Our data demonstrate a correspondence of mean CBFV and rCBF changes evoked by sensorimotor activation in the human brain. Furthermore, cerebral hemodynamic changes related to motor activity are accompanied by cardiorespiratory effects.
Author (Hemer)

A95-71497* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
EFFECTS OF HEAD-DOWN BED REST ON COMPLEX HEART RATE VARIABILITY: RESPONSE TO LBNP TESTING

ARY L. GOLDBERGER, JOSEPH E. MIETUS, DAVID R. RIGNEY, MARGIE L. WOOD, and SUZANNE M. FORTNEY Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2863-2869 Research sponsored by the G. Harold and Leila Y. Mathers Charitable Foundation (Contract(s)/Grant(s): NAG9-514; NIH-R01-HL-42172) (HTN-95-70475) Copyright

Head-down bed rest is used to model physiological changes during spaceflight. We postulated that bed rest would decrease the degree of complex physiological heart rate variability. We analyzed continuous heart rate data from digitized Holter recordings in eight healthy female volunteers (age 28-34 yr) who underwent a 13-day 6 deg head-down bed rest study with serial lower body negative pressure (LBNP) trials. Heart rate variability was measured on a 4-min data sets using conventional time and frequency domain measures as well as with a new measure of signal 'complexity' (approximate entropy). Data were obtained pre-bed rest (control), during bed rest (day 4 and day 9 or 11), and 2 days post-bed rest (recovery). Tolerance to LBNP was significantly reduced on both bed rest days vs. pre-bed rest. Heart rate variability was assessed at peak LBNP. Heart rate approximate entropy was significantly decreased at day 4 and day 9 or 11, returning toward normal during recovery. Heart rate standard deviation and the ratio of high- to low-power frequency did not change significantly. We conclude that short-term bed rest is associated with a decrease in the complex variability of heart rate during LBNP testing in healthy young adult women. Measurement of heart rate complexity, using a method derived from nonlinear dynamics ('chaos theory'), may provide a sensitive marker of this loss of physiological variability, complementing conventional time and frequency domain statistical measures.
Author (Hemer)

A95-71498
ASSESSMENT OF FREQUENCY SHIFTS IN R-R INTERVAL VARIABILITY AND RESPIRATION WITH COMPLEX DEMODULATION

JUNICHIRO HAYANO, J. ANDREW TAYLOR, SEIJI MUKAI, AKIYOSHI OKADA, YOSAKU WATANABE, KAZUYUKI TAKATA, and TAKAO FUJINAMI Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2879-2888 Research sponsored by T. Nanba Memorial Health Care Foundation and the Japanese Ministry of Health and Welfare (HTN-95-70476) Copyright

A complex demodulation (CDM) method for continuous assessment of frequency shifts and time-dependent changes in amplitude in the rythmic components existing in predefined frequency bands was proposed and applied to the analysis of high-frequency (HF) and low-frequency (LF) components of the R-R interval and to the analysis of respiration via impedance spirogram. Simulation studies revealed that this CDM technique furnishes mathematical features well suited to the investigation of nonstationary R-R interval signals and can delineate time-dependent fluctuations in both amplitude and frequency, accurately differentiating between HF and LF components. Analysis of data during paced breathing at different respiratory frequencies revealed that the estimated frequency of the HF component and respiration faithfully reflected the frequency of paced breathing. Analysis of data during dynamic exercise with increasing workload (20 W/min) showed that the frequency of the HF component was elevated with exercise and that both HF and LF amplitudes were reduced progressively with advancing load. CDM-derived frequency and amplitude of respiration were highly correlated to direct breath-by-breath respiratory frequency and tidal volume measurements. We conclude that this method could provide a powerful means for continuously assessing time-dependent changes in both cardiovascular and respiratory variations.
Author (Hemer)

A95-71499
COMPARATIVE AGE-RELATED ACUTE AND CHRONIC PULMONARY OXYGEN TOLERANCE IN RATS

SUSAN LAUDERT, DONALD W. THIBEAULT, MOHAMMAD M. REZAIEKHALIGH, SHERRY M. MARBRY, and MANOP HUNTRAKOON Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2709-2719 Research sponsored by the Katharine B. Richardson Foundation (HTN-95-70477) Copyright

Young rats are thought to be more tolerant to hyperoxia. We propose that this may not be proven and depends on how tolerance is defined. We assessed oxygen tolerance in Sprague-Dawley rats from birth to maturity by comparing survival, lung water, antioxidant

enzyme activity, lung morphometrics, heart weight, and arterial blood gases in newborn and 27-, 44-, 48-, and 96-day-old rats exposed to 100% O2 or room air for 22 days. Some 96-day-old-rats (rest group) received only 50% O2 between 48 and 72 h. Mortality after 5 days of O2 was O% in newborn and 27-day-old rats and 27% in 44-day-old rats but was greater than 80% in 48- and 96-day-old rats. Between 5 and 22 days, the death rate was 100% in newborns, 25% in 27-day-old rats, and 0% in 44- to 96-day-old rats. Death occurred when lung water was greater than 84% except in newborns, which tolerated high lung water for the first 7 days. In chronically exposed 44- and 96-day-old rats, lung water returned to normal. Enzyme activity increased with O2 at all ages but did not relate to survival. In 96-day-old rats, the initial increase was suppressed on day 3. All chronically O2-exposed rats had minimal nonvascular parenchymal changes but developed right ventricular hypertrophy and increased alveolar ductal artery muscularization and lost alveolar capillaries. The most mature rats were least affected. In O2, there was pulmonary insufficiency the first 3 days, followed by recovery, and later hypercarbia and decreased arterial P(sub O2). We conclude that young rats, 0-44 days old, are more O2 tolerant for 5 days. More mature animals surviving 5 days, are more tolerant to chronic exposure. Author (Herner)

A95-71500
RAPID NEUTROPHIL ACCUMULATION AND PROTEIN OXIDATION IN IRRADIATED RAT LUNGS
HENRY FLISS Univ. of Ottawa, Ottawa, Ontario, Canada and MICHEL MENARD Univ. of Ottawa, Ottawa, Ontario, Canada
Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2727-2733 Research sponsored by the Defence Research Establishment
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Exposure of lungs to high doses of ionizing radiation can initiate an injurious acute inflammatory response. We show that neutrophil content in the lungs of rats exposed to 10 Gy whole body gamma radiation increased threefold 4.5 h after irradiation and returned to normal by 24 h. Oxidized methionine in the proteins of the lungs, heart, liver, kidney, and jejunum increased significantly in 2 h. Treatment with the antioxidant dithiothreitol immediately after irradiation prevented methionine oxidation. Methionine oxidation was also observed after intrabronchial instillation of phorbol myristate acetate, a model of neutrophil oxidant-mediated pulmonary injury, as well as in isolated lungs perfused with hypochlorous acid, confirming the ability of neutrophil oxidants to cause protein oxidation in lungs. No change in glutathione or protein sulfhydryl content was detected in irradiated lungs 4.5 h after irradiation, possibly as a result of protection by the observed increases in pulmonary glutathione reductase. We therefore show that the acute pulmonary inflammatory response to radiation involves rapid neutrophil accumulation, oxidant production, and protein oxidation.
Author (Herner)

A95-71501
ROLE OF NONENZYMATICALLY GENERATED PROSTANOID, 8-ISO-PGF(SUB 2 ALPHA) IN PULMONARY OXYGEN TOXICITY
CHARLES A. VACCHIANO Univ. of South Carolina, Charleston, SC, US and GEORGE E. TEMPEL Univ. of South Carolina, Charleston, SC, US
Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2912-2917 Research sponsored by the Tri-Service Nursing Research Program, Uniformed Services Univ. of Health Sciences and the U.S. Navy
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Oxygen delivery at higher than ambient concentrations is in frequent clinical use, yet prolonged exposure can produce pulmonary edema in humans and animals. The specific mediators of oxygen toxicity are unknown, although evidence suggests that oxygen-based radicals such as superoxide anion contribute to this injury. Recently, 8-iso-prostaglandin F(sub 2-alpha) (PGF(sub 2 alpha)), an F(sub 2)-isoprostane formed by free radical-initiated lipid peroxidation of arachidonic acid, has been implicated in pulmonary injury. Nitric oxide (NO) also contributes to tissue oxygen radical load, and although believed to be beneficial, its metabolites may play a pathophysiological role by participating in lipid peroxidation and isoprostane formation. We hypothesized that 8-iso-PGF(sub 2 alpha) and NO levels increase in high oxygen concentrations and that 8-iso-PGF(sub 2 alpha) is associated with lung injury and accumulation of plasma albumin in pulmonary extravascular space. Levels of 8-iso-PGF(sub 2 alpha) in bronchial alveolar lavage fluid (BALF) of rats exposed to 90% O2 at 1 atmosphere for 48 h or 60 h were significantly increased compared with levels in ambient air-exposed control rats. NO levels in BALF of rats exposed to 90% O2 at 1 atmosphere for 60 h were increased 50% compared with NO levels in BALF of rats exposed to ambient air or 48 h of 90% O2. Accumulation of radiolabeled plasma albumin in lung parenchyma or rats inhaling 8-iso-PGF(sub 2 alpha) was also examined. The ratio of lung-associated radioactivity per gram of tissue to blood-associated radioactivity was increased 90% in 8-iso-PGF(sub alpha 2)-exposed group compared with vehicle group. This study provides evidence that hyperoxia induces pulmonary formation of a nonenzymatically derived prostanoid that may be involved in pulmonary oxygen toxicity.
Author (Herner)

A95-71502
BETA-ADRENGERIC EFFECTS ON LEFT VENTRICULAR FILLING: INFLUENCE OF AGING AND EXERCISE TRAINING
JOHN R. STRATTON, WAYNE C. LEVY, ROBERT S. SCHWARTZ, ITAMAR B. ABRASS, and MANUAL D. CERQUEIRA Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2522-2529 Research sponsored by the Medical Research Service of the Dept. of Veterans Affairs
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Reduced heart rate and contractile responses to beta-agonist stimulation characterize normal cardiac aging, but whether diastolic responses also decline with aging has not been determined in humans. Diastolic filling responses to isoproterenol were determined in 13 older (60-82 yr) and 11 young (24-32 yr) healthy men before and after endurance training. Filling rates were expressed in three ways: (1) normalized to end-diastolic volume per second, (2) normalized to stroke volume per second, and (3) as absolute milliliters of blood. Peak early filling rates by all methods were reduced at rest and all isoproterenol doses with aging, whereas peak atrial filling rates were increased with aging. During isoproterenol, both peak early and peak atrial filling rates increased significantly; the increase in filling rates with isoproterenol was not different with aging (all NS for old vs. young x dose). Endurance training did not augment diastolic filling responses to isoproterenol. Although diastolic filling rates at rest are markedly altered by aging, distolic filling responses to isoproterenol are not reduced with aging. Thus the age-associated declines in heart rate, ejection fraction, and cardiac output responses to beta-adrenergic stimulation with isoproterenol do not extend to diastolic filling responses.
Author (Herner)

A95-71503
REGULATION OF BIOENERGETICS IN O2-LIMITED ISOLATED RAT HEARTS
MICHELE SAMAJA Univ. of Milan, Milan, Italy, STEFANIA CASALINI Univ. of Milan, Milan, Italy, SONIA ALLIBARDI Univ. of Milan, Milan, Italy, ANTONIO CORNO Univ. of Milan, Milan, Italy, and SERGIO L. CHIERCHIA Univ. of Milan, Milan, Italy Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2530-2536 Research sponsored by Consiglio Nasionale delle Ricerche Target Project Biotecnology and Biostruments and Foundazione San Romanello del Monte Tabor
(HTN-95-70481) Copyright

Assessing the role of O2 supply in the regulation of cardiac function in O2-limited hearts is crucial to understanding myocardial ischemic preconditioning and adaptation to hypoxia. We exposed isolated Langendorff-perfused rat hearts to either ischemia (low coronary flow) of hypoxemia (low P(sub O2) in the perfusing medium) with matched O2 supply (10% of baseline). Myocardial contractile work and ATP turn-over were greater in hypoxemic than in ischemic hearts. Thus, the energy demand was higher during hypoxemia than during ischemia, suggesting that ischemic hearts

are more downregulated than hypoxemic hearts. Venous P(sub O2) was 12 +/- 2 and 120 +/- 15 Torr for ischemic and hypoxemic hearts, respectively, but O2 uptake was the same. Lactate release was higher during hypoxemia than during ischemia. Electrical stimulation increased performance in ischemic but not in hypoxemic hearts without changes in venous P(sub O2) or O2 uptake. However, venous lactate concentration and lactate release increased in ischemic but not in hypoxemic hearts, suggesting that anaerobic glycolysis provides the energy necessary to meet the increased energy demand in ischemic hearts only. We conclude that high intracellular lactate or H(+) concentration during ischemia plays a major role as a downregulating factor. Downregulation disappears in hypoxemic hearts secondary to enhanced washout of lactate or H(+). Author (Herner)

A95-71504
CONTRIBUTION OF POSTASSIUM TO EXERCISE-INDUCED VASODILATION IN HUMANS
JOHN R. WILSON, SHIV C. KAPOOR, and G. GOPAL KRISHNA Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2552-2557 Research sponsored by Veterans Affairs
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It has been postulated that skeletal muscle release of potassium contributes to exercise-induced vasodilation of skeletal muscles arteioles. To determine whether potassium produces muscle arteriolar vasodilation in humans, we measured plethysmographic forearm blood flow and brachial venous potassium concentrations during brachial arterial infusion of potassium in nine normal subjects. Infusion of postassium decreased forearm vascular resistence, with an increase in brachial venous potassium, of 1 meq/l decreasing foprearm vascular tone by 25-30%. We then measured plasma potassium concentrations during forearm and upright bicycle exercise in 15 normal subjects. Forearm exercise at 0.6 W decreased forearm vascular resistance by 83%, whereas brachial venous potassium increased by only 0.5 +/- 0.2 meq/l. Maximal bicycle exercise increased systemic potassium concentrations by 1.2 +/- 0.2 meq/l. These findings indicate that potassium produces muscle arteriolar vasodilation in humans and therefore supports the hypothesis that potassium release from exercising muscle contributes to exercise-induced vasodilation. The relatively small change in venous potassium noted during forearm exerices despite marked forearm vasodilation suggests that local potassium relases is only a small contributor to exercise-induced vasodilation. However, potassium release during maximal exercise may have significant vasodilatory effects on arterioles both in exercising and nonexercising.
Author (Herner)

A95-71505
VOLUME-HOMEOSTATIC MECHANISMS IN HUMANS DURING GRADED WATER IMMERSION
ANDERS SCHERMACHER LARSEN, LARS BO JOHANSEN, CARSTEN STADEAGER, JORGEN WARBERG, NIELS JUEL CHRISTENSEN, and PETER NORSK Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2832-2839 Research sponsored by Danish Space Board
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The purpose of this experiment was to investigate whether a graded increase in cardiac distension induced by graded water immersion (WI) could be related to endocrine responses and renal sodium excretion (U(sub Na)V). On 3 separate days, nine healthy males were investigated in the upright seated position before, during, and after 3 h of WI to the midchest (CI) or to the neck (NI) or during control. Central venous pressure increased twice as much during NI as during CI. U(sub Na)V increased to the same extent during NI compared with CI, whereas urine flow rate, solute-free water clearance, and osmotic excretion increased more during the 2nd h of NI than during CI. During NI, the plasma concentration of atrial natriuretic peptide (ANP) increased twice as much as during CI. The plasma concetrations of aldosterone and norepinephrine were decreased in a similar manner during NI compared with CI. In conclusion, graded cardiac distension induced by graded WI and accompanied by a graded release of ANP was not accompanied by a graded increase in U(sub Na)V. Thus either a cardiac distension pressure of approximately one-half of that during NI is enough to induce a maximum U(sub Na)V during WI or other stimuli are important. Furthermore, aldosterone and norepinephrine are probably more important mediators of the natriuresis of WI in humans than is ANP. Author (Herner)

A95-71506
ALTERED MECHANICAL PROPERTIES OF LUNG PARENCHYMA IN POSTOBSTRUCTIVE PULMONARY VASCULOPATHY
SUZANNE M. KELLY McGill Univ., Montreal, Quebec, Canada, JASON H. T. BATES McGill Univ., Montreal, Quebec, Canada, and RENE P. MICHEL McGill Univ., Montreal, Quebec, Canada Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2543-2551 Research sponsored by Medical Research of Canada and the Quebec Lung Association
(HTN-95-70484) Copyright

Postobstructive pulmonary vasculopathy (POPV) produced by chronic unilateral ligation of one pulmonary artery, results in perfusion of the pulmonary capillaries with systemic arterial blood. As a consequence, gas exchange occurs primarily in the contralateral nonligated lung. To determine whether the mechanical properties of the lung paranchyma are changed in POPV, we compared five dogs with chronic ligation of the left main pulmonary artery with five control dogs. Separate measurements of left and right lung airway flows, tracheal pressures, and alveolar pressures were made during mechanical ventilation at frequencies between 5 and 40 breaths/min. We calculate pulmonary elastance (EL) and pulmonary (RL), airway (Raw), and tissue (Rti) resistances. At all frequencies, dogs with POPV had higher left (ligated) EL and Rti and lower right (normal) lung Rti but similar EL compared with the respective lungs from control animals. Raw was the same in both lungs. Histology showed visceral pleura thickening and encroachment of new bronchial collaterals and lympathatics on the parenchyma of the ligated lungs. The contralateral lungs were entirely normal. We conclude that in POPV (1) there is an increase, in the ligated lung, of both EL and RL, the latter likely due to histological changes of the lung parenchyma, and (2) there is a reduction of Rti in the contralateral lung. Author (Herner)

A95-71507
EFFECT OF INHALED BUDESONIDE ON OZONE-INDUCED AIRWAY HYPERRESPONSIVENESS AND BRONCHOALVEOLAR LAVAGE CELLS IN DOGS
W. H. M. STEVENS, E. ADELROTH, J. WATTIE, M. J. WOOLLEY, R. ELLIS, M. DAHLBACK, and P. M. O'BYRNE Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2578-2583 Research sponsored by Respiratory Health Network of Centers of Excellence and the Medical Research Council of Canada
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Inhaled corticosteroids are known to reduce components of the airway inflammation characteristic of asthma and improve airway hyperresponsiveness. However, the effect of inhaled corticosteroids on ozone-induced airway responses is unknown. Eight dogs inhaled budesonide or lactose powder twice daily for 7 days before inhaling ozone (3 ppm for 30 min) or dry air. Acetylcholine airway responsiveness was measured before and 1 h after ozone, followed by a bronchoalveolar lavage (BAL). The response to acetylcholine was expressed as the concentration causing an increase in lung resistance of 5 cmH2O/l/s above baseline (acetylcholine provacation concentration). Budesonide pretreatment significantly attenuated the ozone-induced increase in pulmonary resistance and neutrophil influx into BAL and significantly reduced BAL eosinophils. However, budesonide pretreatment had no significant effect on ozone-induced airway hyperresponsiveness. After budesonide, the acetylcholine provocative concentration fell from 5.96 mg/ml before to 1.11 mg/ml after ozone. After lactose, the acetylcholine provocative concentration fell from 5.34 mg/ml before to 0.50 mg/ml after ozone. Dry air inhalation did not

cause airway hyperresponsiveness. These results suggest that ozone-induced airway hyperresponsiveness is steroid resistant and that airway neutophils or eosinophils are not important in its pathogenesis. Author (Herner)

A95-71508
LONGITUDINAL DISTRIBUTION OF OZONE ABSORPTION IN THE LUNG: COMPARISON OF NASAL AND ORAL QUIET BREATHING
JOSEPH R. KABEL Pennsylvania State Univ., University Park, PA, US, ABDELLAZIZ BEN-JEBRIA Pennsylvania State Univ., University Park, PA, US, and JAMES S. ULTMAN Pennsylvania State Univ., University Park, PA, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2584-2592 Research sponsored by US Environmental Protection Agency
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Employing a bolus inhalation system, we noninvasively measured the fraction of inhaled ozone (O3) that is absorbed during a single breath (lambda) as a function of bolus penetration volume into the respiratory tract (Vp). During nasal breathing at a constant repiratory flow of 250 ml/s, lambda increased smoothly as Vp increased with 80% of the inhaled O3 absorbed in the upper airways and 90% absorbed at the distal end of the trachea. Oral breathing caused a distal shift of the lambda-Vp distribution to the extent that absorption in the upper airways was reduced to 50% and inhaled O3 was 90% absorbed only after a bolus reached the 13th bronchial generation. Therefore, an exercise-induced change from nasal to oral breathing can render the distal lung more susceptible to O3 damage because of an elevation in O3 dose. We also found that changing the peak inhaled bolus concentration over a 10-fold range of 0.04-4 ppm O3 did not affect the lambda-Vp distribution. This finding implies that the diffusion and chemical reaction dynamics that dictate O3 absorption are linear processes. Author (Herner)

A95-71509
DYNAMIC SURFACE TENSION OF SURFACTANT TA: EXPERIEMENTS AND THEORY
D. R. OTIS, JR., E. P. INGENITO, R. D. KAMM, and M. JOHNSON Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2681-2688 Research sponsored by the Whitaker Foundation and the Freeman Foundation
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A bubble surfactometer was used to measure the surface tension of an aqueous suspension of surfactant TA as a function of bubble area over a range of cycling rates and surfactant bulk concentrations. Results of the surface tension-interfacial area loops exhibited a rich variety of phenomena, the character of which varied systematically with frequency and bulk concentration. A model was developed to interpret and explain these data and for use in describing the dynamics of surface layers under more general circumstances. Surfactant was modeled as a single component with surface tension taken to depend on only the interfacial surfactant concentration. Two distinct mechanisms were considered for the exchange of surfactant between the bulk phase and interface. The first is described by a simple kinetic relationship for absorption and desorption that pertains only when the interfacial concentration is below its maximum equilibrium value. The second mechanism is 'squeeze-out' by which surfactant molecules are expelled from an interface compressed past a maximum packing state. The model provided good agreement with experimental measurements for cycling rates from 1 to 100 cycles/min and for bulk concentrations between 0.0073 and 7.3 mg/ml. Author (Herner)

A95-71510
EFFECTS OF ACUTE LUNG INJURY ON DYNAMIC TISSUE PROPERTIES
EDWARD P. INGENITO, LENA MARK, and BRIAN DAVIDSON Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2689-2697 Research sponsored by the Whitaker Foundation
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(HTN-95-70488) Copyright

The dynamic properties of lung tissue after acute injury (ALI) were characterized by studying parenchymal strips prepared from guinea pigs endobronchially treated with hydrochloric acid. Forty-eight-hour samples from control (C), acid-damaged (D), and uninvolved (U) lungs of treated animals had elastance and resistance measured in a perfused organ bath system during uniaxial length oscillation at a mean force of 750 mg over a 1.5 (0.1-3 Hz)-fold decade frequency range and 5-fold (1-5%) strain amplitude range. Results were interpreted using a quasilinear viscoelastic model with tissue stress expressed as an expotential function of strain. Among C strips, elastance increased linearly with the logarithm of frequency, whereas resistance decreased hyperbolically with frequency; both were strain amplitude independent. In contrast, elastance among D strips was uniformly greater and was inversely strain amplitude dependent; resistance was markedly elevated but decreased hyperbolically with frequency similar to C strips. Resistance and elastance changes among U strips were intermediate between those for D and C strips. Histological grading of cellular infiltration, alveolar septal thickening, and hemorrhage correlated with functional changes. The frequency and amplitude dependencies and magnitude changes for resistance and elastance were similar to those previously observed in intact dog lungs after ALI. These findings suggest that ALI can affect the rheological properties of lung parenchyma independently of surfactant and that changes in lung mechanics after ALI may, in part, be determined at the parenchymal level. Author (Herner)

A95-71511
EFFECTS OF AIRWAY PARASYMPATHETIC TONE ON REPONSES TO INTRAVENOUS BRONCHOCONSTRICTOR AGONISTS IN RATS
RONALD SORKNESS Univ. of Wisconsin, Madison, WI, US, JENNIFER CLOUGH Univ. of Wisconsin, Madison, WI, US, and ROBERT F. JR. LEMANSKE Univ. of Wisconsin, Madison, WI, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2698-2702
(Contract(s)/Grant(s): NIH-AI-10404; NIH-HL-44098; NIH-AI-00995)
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To test the hypothesis that parasympathetic airway tone may affect airway responsiveness, we measured bronchoconstrictor responses to intravenous bethanechol (BCh) in anesthetized vagotomized rats with and without background vagal nerve stimulation and developed a predictive model based on pharmacological additivity between endogenous and intravenous agonists. A high degree of agreement between the measured and predicted responses indicated that intravenous BCh and parasympathetic tone had bronchoconstrictor effects that were pharmacologically additive. An expansion of the additive model was used to determine that the percentage of decrease in respiratory system conductance (Grs) would be a measure of airway response independent of background parasympathetic tone. As predicted, the percentage of decrease in Grs after intravenous BCh was minimally affected by background vagal stimulation. However, the percentage of decrease in Grs was augmented by vagal stimulation for intravenous 5-hydroxytryptamine hydrochloride, a known parasympathetic neuromodulator, and for methoacholine, an agonist with nicotinic as well as muscarinic activity. We conclude that airway parasympathetic tone can be a source of variability for airway responsiveness when substances having neuromodulatory activity are involved in the provocative challenge. Author (Herner)

A95-71512
RELATIONSHIP BETWEEN DOT-CR AND BREATHING PATTERN IN MECHANICALLY VENTILATED PATIENTS
HENRI BURNET, MYLENE BASCOU-BUSSAC, CLAUDE MARTIN, and YVES JAMMES Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2703-2708

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In mechanically ventilated patients the natural gas-conditioning process of the upper airways is bypassed by the use of an endotracheal tube or a tracheostomy. We hypothesized that under these conditions the breathing pattern may greatly influence the convective respiratory heat loss (dot-Cr). Dot-Cr values were computed from minute ventilation (dot-VE) and inspiratory and expiratory gas temperatures, which were measured in six patients under mechanical ventilation for the management of cranial trauma. In each patient the effects of 11-20 different breathing patterns were investigated. Relationships between dot-Cr and dot-VE and between combined tidal volume and respiratory frequency were obtained by simple and multiple linear regression methods, respectively. Comparison of the standard errors of estimate indicated that multiple linear regression gives the best fit. Thus, dot-Cr was highly dependent on the breathing pattern and was not related only to dot-VE. For the same dot-VE value, dot-Cr was higher when dot-VE was achieved with high tidal volume and low respiratory frequency. These data are consistent with previous studies in which thermal exchanges through the upper airways were taxed by hyperventilation of frigid air. Author (Herner)

A95-71513
VALIDATION OF NEAR-INFRARED SPECTROSCOPY IN HUMANS

DONNA M. MANCINI Univ. of Pennsylvania, Philadelphia, PA, US, LIZANN BOLINGER Univ. of Pennsylvania, Philadelphia, PA, US, HAO LI Univ. of Pennsylvania, Philadelphia, PA, US, KEITH KENDRICK Univ. of Pennsylvania, Philadelphia, PA, US, BRITTON CHANCE Univ. of Pennsylvania, Philadelphia, PA, US, and JOHN R. WILSON Univ. of Pennsylvania, Philadelphia, PA, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2740-2747 Research sponsored by the National Heart Association

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Near-infrared (NIR) spectroscopy is a noninvasive technique that uses the differential absorption properties of hemoglobin to evaluate skeletal muscle oxygenation. Oxygenated and deoxygenated hemoglobin absorb light equally at 800 nm, whereas at 760 nm absorption is primarily from deoxygenated hemoglobin. Therefore, monitoring these two wavelengths provides an index of deoxygenation. To investigate whether venous oxygen saturation and absorption between 760 and 800 nm (760-800 nm absorption) are correlated, both were measured during forearm exercise. Significant correlations were observed in all subjects. The contribution of skin flow to the changes in 760-800 nm absorption was investigated by simultaneous measurement of skin flow by laser flow Doppler and NIR recordings during hot water immersion. Changes in skin flow but not 760-800 nm absorption were noted. Intra-arterial infusions of nitroprusside and norepinephrine were performed to study the effect of alteration of muscle perfusion on 760-800 nm absorption. Limb flow was measured with venous plethysmography. Percent oxygenation increased with nitroprusside and decreased with norepinephrine. Finally, the contribution of myoglobin to the 760-800 nm absorption was assessed by using H-1-magnetic resonance spectroscopy. At peak exercise, percent NIR deoxygenation during exercise was 80 +/- 7%, but only one subject exhibited a small deoxygenated myoglobin signal. In conclusion, 760-800 nm absorption is (1) closely correlated with vensous oxygen saturation, (2) minimally affected by skin blood flow, (3) altered by changes in limb perfusion, and (4) primarily derived from deoxygenated hemoglobin and not myoglobin. Author (Herner)

A95-71514
REGIONAL DIAPHRAGM SHORTENING MEASURED BY SONOMICROMETRY

Y. WAKAI Univ. of British Columbia, Vancouver, BC, Canada, A. M. LEEVERS Univ. of British Columbia, Vancouver, BC, Canada, and J. D. ROAD Univ. of British Columbia, Vancouver, BC, Canada Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2791-2796 Research sponsored by the Medical Research Council of Canada

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Diaphragmatic shortening measured by sonomicrometry has been compared in the two major anatomic segments, costal and crural. Data obtained by videofluoroscopy found a variation in subsegmental shortening within segments. No reproducible pattern of subsegmental shortening has emerged, and the mechanisms leading to this subsegmental variation in shortening are unknown. Therefore, we compared subsegmental shortening in both segments of the diaphragm in seven supine pentobarbital-anesthetized dogs. Seven pairs of sonomicrometer transducers were implanted in the two segments, and subsegmental shortening during spontaneous breathing was measured. To determine potential mechanisms contributing to the variation in shortening, measurements were made during stimulated breathing, after epiphrenic stimulation, and during occluded breaths. We found electrical stimulation at physiological frequencies of 10 and 20 Hz reduced the variation in subsegmental shortening, whereas stimulated breathing did not. Occluded breaths showed a consistent decrease in the amount of shortening, particularly in the dome of the costal diaphragm, compared with shortening in the area of apposition. Comparison of shortening between segments revealed greater crural than costal shortening. We conclude that subsegmental variation in activation can contribute to variation in subsegmental shortening and that the afterload can effect shortening during occluded breaths. Author (Herner)

A95-71515
OXYGEN TRANSPORT TO TISSUE BY PERSISTENT BUBBLES: THEORY AND SIMULATIONS

MARK E. BURKARD Univ. of Buffalo, Buffalo, NY, US and HUGH D. VAN LIEW Univ. of Buffalo, Buffalo, NY, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2874-2878 Research sponsored by Sonus Pharmaceuticals

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Persistent gas bubbles able to traverse capillaries can be prepared from a slowly permeating gas or with a mechanical structure surrounding a gas phase. If they are permeable to gases, such bubbles will carry O2 from the lungs to the tissues via the blood stream. Using a mathematical model based on physical laws, we present simulations of the behavior of bubbles stabilized by a slowly permeating gas (gas X). We show that the bubble persists longer if the tissue and venous blood contain N2 to dilute gas X and slow its outward diffusion. A 6-micrometer-diam bubble carries 0.11 pl of O2 during the breathing of pure O2, so 4.6 x 10(exp 8) bubbles/ml in the blood will supply a normal arteriovenous difference. In conditions used for hyperbaric O2 therapy, a bubble carries approximately 0.26 pl of O2. Stabilized bubbles have the potential to transport O2 efficiently; they release O2 to tissue at high P(sub O2) and require injection of only small amounts of a foreign substance. Author (Herner)

A95-71516
ONE-DIMENSIONAL SIMULATION OF AEROSOL TRANSPORT AND DEPOSITION IN THE HUMAN LUNG

CHANTAL DARQUENNE Free Univ. of Brussels, Brussels, Belgium and MANUEL PAIVA Free Univ. of Brussels, Brussels, Belgium Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2889-2898 Research sponsored by Services Federaux des Affaires Scientifiques

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One-dimensional transport models (trumpet model and multi-branch-point model) derived from those developed to study gas transport and mixing in the lung are used to simulate aerosol deposition as a function of particle diameter and aerosol dispersion of inhaled bolus in human lungs. In agreement with previous studies, aerosol deposition is satisfactorily simulated by the different models. However, the differences between simulations and experiments of aerosol bolus dispersion suggest that current models are not realistic. This is probably due to the intrinsic limitations of the one-dimensional models to describe aerosol transport in the lung periphery. We show that future model analysis can probably use a symmetric acinar structure like the classic Weibel model of the lung but that multidimensional particle

transport equations are required. Furthermore, a rigorous description of aerosol dispersion in the oral-laryngeal path is also needed. Author (Herner)

A95-71517
INFLUENCE OF SITE OF TRACHEAL PRESSURE MEASUREMENT ON IN SITU ESTIMATION OF ENDOTRACHEAL TUBE RESISTANCE
PAOLO NAVALESI, PAUL HERNANDEZ, DENNY LAPORTA, JENNIFER S. LANDRY, FRANCOIS MALTAIS, DANIEL NAVAJAS, and STEWART B. GOTTFRIED Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2899-2906 Research sponsored by the Respiratory Health Network of Centres of Excellence, the Medical Research Council of Canada, the J. T. Costello Memorial Research Fund, the Montreal Chest Hospital Centre Research Institute
(HTN-95-70495) Copyright

In situ measurement of distal tracheal pressure (Prt) via an intraluminal side-hole catheter (IC) has been used to determine endotracheal tube (Rett) and intrinsic patient (Rpt) resistances in intubated subjects. Because of differences in cross-sectional area between the endotracheal tube (ETT) and trachea, fluid dynamic principles predict that IC position should critically influence these results. Accordingly, the aim of this study was to determine the effect of IC position on Rett. Prt was recorded in vitro through an IC from 2 cm inside, at the tip of, or 2 cm outside an ETT (7, 8, and 9 mm ID) situated within an artificial trachea (13, 18, and 22 mm ID). A reference value of Rett was also obtained. Results were unaffected by IC position during inspiration, overestimating Rett by 7.9 +/- 0.7% (SE). In constrast, during expiration, Rett fell as IC position changed from outside to inside the ETT and was underestimated by 41.3 +/ - 3.6% with Ptr recorded inside the ETT. Varying ETT or tracheal size had little effect on the relative error in Rett. The IC itself did increase Rett due to a reduction in effective cross-sectional area, the change varying directly with IC size and inversely with ETT caliber. In vivo values in 11 intubated patients were comparable to in vitro results. In summary, IC position and size can have important consequences on in situ measurements of Prt and should be considered when clinically monitoring Rett of Rpt. Author (Herner)

A95-71518
TIME COURSE OF BLOOD VOLUME CHANGES IN AN ISOLATED LUNG LOBE AFTER VENOUS PRESSURE ELEVATION
MICHAEL B. MARON Northeastern Ohio Universities College of Medicine, Roostown, Ohio, US and SUSAN M. LANE Northeastern Ohio Universities College of Medicine, Roostown, Ohio, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2720-2726
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(HTN-95-70496) Copyright

The elevation of venous pressure (Pv) in isolated perfused organs causes organ weight to increase in a biphasic manner. The initial rapid phase results primarily from an increase in blood volume (BV), whereas the second slower phase is generally considered to reflect fluid filtration. Recent studies have suggested, however, that BV may continue to increase during the slow weight gain phase. To address this question, we made serial measurements of circulating BV by indicator dilution with indocyanine green dye in a canine isolated perfused left lower lung lobe (LLL) preparation during 40 min of Pv elevation. Pv was raised to approximately 18 Torr in six LLLs beginning an average of 28 min after the start of perfusion. After an initial rapid increase, BV continued to increase at a slower rate for approximately 30 min. The increase in BV observed between 3 and 40 min of Pv elevation was 47.9 +/- 9.1% of the weight gain that occurred during this period. In six additional LLLs, Pv elevation was delayed until approximately 70 min after the perfusion was started. In these LLLs, BV generally achieved constancy 3 min after Pv was elevated. These data indicate that the dynamcis of the BV response of this preparation to Pv elevation is time dependent and that gravimetric determinations of the rate of fluid filtration may substantially overestimate the true filtration rate in the presence of continuing increased in BV. The increases in BV observed in the first group of LLLs appear to be due to vascular recruitment rather than stress relaxation. Author (Herner)

A95-71519
TNF POTENTIATES PAF-INDUCED PULMONARY VASOCONSTRICTION IN THE RAT: ROLE OF NEUTROPHILS AND THROMBOXANE A(SUB 2)
SHIH-WEN CHANG Northwestern Univ. Medical School, Chicago, IL, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2817-2826 Research sponsored by the Dept. of Veterans Affairs and the American Lung Association (Contract(s)/Grant(s): NIH-HL-01966)
(HTN-95-70497) Copyright

Both tumor necrosis factor (TNF) and platelet-activating factor (PAF) are released during sepsis and are important mediators of septic lung injury. I investigated the interactions of TNF and PAF on vasoactive responses in the pulmonary circulation. In isolated rat lungs perfused with a cell- and plasma-free physiological salt solution, PAF caused transient dose-dependent pulmonary arterial and venous constrictions. In vivo pretreatment of the rats with TNF 1 h before lung isolation increased lung myeloperoxidase activity and markedly enhanced PAF-induced pulmonary vasoconstriction without affecting the pressor responses to angiotensin II or hypoxia. In constrast, pretreatment with lipopolysaccharide, which increased lung myeloperoxidase to the same extent as TNF, caused only a modest enhancement of PAF-induced vasoconstriction associated with reduced pressor responses to angiotension II and hypoxia. Ex vivo perfusion of isolated lungs with TNF for 1 h did not affect PAF vasoconstriction. The TNF-induced potentiation of PAF vasoconstriction was not altered by depletion of circulating neutrophils with vinblastine but was blocked by Dazmegrel, a thromboxane synthase inhibitor. Thus, TNF potentiates PAF-induced pulmonary vasoconstriction by an in vivo mechanism that is neutrophil independent but thromboxane dependent. This TNF-PAF interaction likely contributes to the development of pulmonary hypertension during sepis. Author (Herner)

A95-71520
EFFECT OF CHRONIC HYPOXIA ON PULMONARY VASCULAR PRESSURES IN ISOLATED LUNGS OF NEWBORN PIGS
CANDICE D. FIKE Univ. of Utah Medical Center, Salt Lake City, Utah, US and MARK R. KAPLOWITZ Univ. of Utah Medical Center, Salt Lake City, Utah, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2853-2862 Research sponsored by the American Heart Association
(Contract(s)/Grant(s): NIH-R-29-HL-42883)
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Our purposes were to determine whether chronic alveolar hypoxia altered pulmonary vascular pressures in lungs of newborn pigs, evaluate the contribution of smooth muscle tone to alterations in pulmonary vascular pressures, and examine whether chronic hypoxia altered pulmonary vascular reactivity to acute hypoxia. We kept 24- to 72-h-old pigs in chambers filled with room air (control) or 11-12% O2 (chronic hypoxia) for either 3-5 (short) or 10-12 (long) days. We used isolated lungs and applied micropuncture and vascular occlusion techniques to measure pressure in 10- to 30-micrometer-diam venules and inflow occlusion and outflow occlusion pressures before and after the addition of the smooth muscle dilator papaverine of before and after inflation of the lungs with a hypoxia gas mixture. For pigs in both the short and long groups, pulmonary arterial pressure was the only vascular pressure that was greater in chronically hypoxic than in control lungs. Increased smooth muscle tone was the primary source of the change in pulmonary arterial pressure with short hypoxia, whereas morphometric changes contributed to the change in pulmonary arterial pressure with long hypoxia. Exposure of newborn pigs to different

lenghts of alveolar hypoxia is a useful model to study postnatal pulmonary hypertension in newborn and infants. Author (Herner)

A95-71521
THE NEED TO SCALE FOR DIFFERENCES IN BODY SIZE AND MASS: AN EXPLANATION OF KLEIBER'S 0.75 MASS EXPONENT
ALAN M. NEVILL Univ. of Birmingham, Birmingham, UK Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 6 December 1994 p. 2870-2873
(HTN-95-70499) Copyright

When modeling intraspecific relationships between selected measurements (Y) or differences in body mass (m) using the allometric equation Y = am(exp b) (where a is a constant and b is the exponent parameter), various studies have reported exponents greater than the anticipates 2/3, often closer to the exponent 0.75 identified by Kleiber. A possible explanation for these exponents is proposed based on the findings of Alexander et al., who observed that, within a variety of species, larger mammals having a greater proportion of proximal leg muscle mass in relation to their body mass, m(exp 1.1). If subjects that are used to record Y exhibit a similar disproportionate increase in muscle mass with body size, then the allometric equation is likely to identify both a contribution proportional to the subject's body mass and a contribution from the disproportionate increase in muscle mass within the group. These confounding influences in Y can be identified separately by incorporating a body size parameter as well as a mass component in the allometric equation. The factor 'body size' can be introduced either by partitioning the sample into discrete subgroups according to body size or, in studies involving human subjects, by introducing height as a continous covariate. In both studies reported involving human maximal exercise, these methods were able to identify a systematic increase in Y with body size, leaving the subject's body mass component, found to be proportional to m(exp 2/3), independent of body size. Author (Herner)

A95-71754
INTELLIGENT SYSTEMS BASED ON ORDERED ARRAYS OF BIOLOGICAL MOLECULES USING THE LB TECHNIQUE
LYNNE A. SAMUELSON U.S. Army Natick Research, Development & Engineering Cent, Natick, MA, United States, BONNIE WILEY, DAVID L. KAPLAN, SANDIP SENGUPTA, MANJUNATH KAMATH, JEONG OK LIM, MARIO CAZECA, JAYANT KUMAR, KENNETH A. MARX, and SUKANT K. TRIPATHY Journal of Intelligent Material Systems and Structures (ISSN 1045-389X) vol. 5, no. 3 May 1994 p. 305-310
(BTN-94-EIX94381359517) Copyright

The Langmuir-Blodgett (LB) technique has been used to incorporate photodynamic proteins into molecular assemblies. One technique of incorporation involves a generalized cassette attachment methodology which employs a biotin-streptavidin complexation with an electroactive polymer matrix. We have focused the efforts described here on phycobiliproteins and bacteriorhodopsin, although antibodies, enzymes, gene probes and other moieties could also be coupled into the system to build in selectivity. Photoconductivity and photobleaching of these protein systems were investigated. These results suggest that coupling these proteins, either in mixed monolayers or in multilayers, with appropriate conductive polymers or other materials will provide the optoelectronic signal transduction needed for biosensor, optical display and other applications. Initial studies involving the integration of conductive polymers into the molecular assemblies to enhance optical signal transduction are also discussed. Author (EI)

A95-72081* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
LIFE FROM THE STARS?
YVONNE J. PENDLETON NASA. Ames Research Center, Moffett Field, CA, US and DALE P. CRUIKSHANK NASA. Ames Research Center, Moffett Field, CA, US Sky & Telescope (ISSN 0037-6604) vol. 87, no. 3 March 1994 p. 36-42
(HTN-95-20821) Copyright

Scientists are now seriously considering the possibility that organic matter from interstellar space could have influenced, or even spurred, the origin of life on Earth. Various aspects of chemical evolution are discussed along with possible extraterrestrial sources responsible for contributing to Earth's life-producing, chemical composition. Specific topics covered include the following: interstellar matter, molecular clouds, asteroid dust, organic molecules in our solar system, interplanetary dust and comets, meteoritic composition, and organic-rich solar-system bodies. Herner

A95-72547* National Aeronautics and Space Administration, Washington, DC.
THE LIMITS OF TEMPLATE-DIRECTED SYNTHESIS WITH NUCLEOSIDE-5'-PHOSPHORO(2-METHYL)IMIDAZOLIDES
AUBREY R. HILL Salk Inst. for Biological Studies, San Diego, CA, US, LESLIE E. ORGEL Salk Inst. for Biological Studies, San Diego, CA, US, and TAIFENG WU Northwestern Univ., Evanston, IL, US Origins of Life and Evolution of the Biosphere (ISSN 0169-6149) vol. 23, no. 5-6 December 1993 p. 285-290
(Contract(s)/Grant(s): NAGW-1660)
(HTN-95-A0476) Copyright

In earlier work we have shown that C-rich templates containing isolated A, T or G residues and short oligo(G) sequences can be copied effectively using nucleoside-5'-phosphoro(2-methyl)imidazolides as substrates. We now show that isolated A or T residues within an oligo(G) sequence are a complete block to copying and that an isolated C residue is copied inefficiently. Replication is possible only if there are two complementary oligonucleotides each of which acts as a template to facilitate the synthesis of the other. We emphasize the severity of the problems that need to be overcome to make possible non-enzymatic replication in homogeneous aqueous solution. We conclude that an efficient catalyst was involved in the origin of polynucleotide replication. Author (Herner)

A95-72548
UTILIZATION OF COFACTORS EXPANDS METABOLISM IN A NEW RNA WORLD
GREGORY J. CONNELL Colorado Univ., Boulder, CO, US and ERIC L. CHRISTIAN Colorado Univ., Boulder, CO, US Origins of Life and Evolution of the Biosphere (ISSN 0169-6149) vol. 23, no. 5-6 December 1993 p. 291-297 Research sponsored by MRC and W. M. Keck Foundation]
(Contract(s)/Grant(s): NIH-GM-30881)
(HTN-95-A0477) Copyright

RNA has been hypothesized to have preceded proteins as the major catalysts of the biosphere, yet there are only a very limited number of chemical reactions that are known to be catalzed by modern RNA. Cofactors are used by the majority of protein enzymes to supply additional functional groups to the active site. RNA should also be able to utilize some of these same cofactors to extend its own catalytic potential. We describe here how it could be possible to use selection-amplification from a population of random RNA to obtain a coenzyme A mediated RNA transacylase. Exploitation of some of the sulphur chemistry mediated by coenzyme A could have significantly expanded a prebiotic RNA directed metabolism. Author (Herner)

A95-72549
N6-SUBSTITUTED ADENINE DERIVATIVES AND RNA PRIMITIVE CATALYSTS
JEAN-LUC DECOUT J. Fourier Univ., Grenoble, France and MARIE-CHRISTINE MAUREL Inst. Jacques Monod, Paris, France Origins of Life and Evolution of the Biosphere (ISSN 0169-6149) vol. 23, no. 5-6 December 1993 p. 299-306
(HTN-95-A0478) Copyright

In our search for primitive RNA catalysts, we noticed that N6-ribosyl-adenine, a compound easily synthesized under presumed prebiotic conditions, has a free imidazole group. We showed that it is, as a catalyst, a potential analogue of hisidine. Furthermore,

among the chemical groups involved in protein catalysis, the imidazole ring of histidine has no equivalent in the RNA world. We have synthesized aliphatic amino groups containing polymers with adenine rings linked to macromolecules by their 6-amino group. These polymers exhibit pronounced catalytic activities in the hydrolysis of p-nitrophenylacetate. We discuss here the fact that in primitive catalysis the imidazole group could have been replaced by N6-substituted adenine derivatives. Author (Herner)

A95-72550* National Aeronautics and Space Administration, Washington, DC.
CATALYSIS AND PREBIOTIC RNA SYNTHESIS
JAMES P. FERRIS Rensselaer Polytechnic Inst., Troy, NY, US Origins of Life and Evolution of the Biosphere (ISSN 0169-6149) vol. 23, no. 5-6 December 1993 p. 307-315
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The essential role of catalysis for the origins of life is discussed. The status of the prebiotic synthesis of 2',5'- and 3'5'-linked oligomers of RNA is reviewed. Examples of the role of metal ion and mineral catalysis in RNA oligomer formation are discussed. Author (Herner)

A95-72551* National Aeronautics and Space Administration, Washington, DC.
IS LIGATION THE ONLY SOLUTION TO THE PYROPHOSPHATE PROBLEM?
J. VISSCHER Nijmegen Univ., Nijmegon, Netherlands, R. JONGBLOETS Nijmegen Univ., Nijmegon, Netherlands, and ALAN W. SCHWARTZ Nijmegen Univ., Nijmegon, Netherlands Origins of Life and Evolution of the Biosphere (ISSN 0169-6149) vol. 23, no. 5-6 December 1993 p. 317-321
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(HTN-95-A0480) Copyright

Pyrophosphate linkages are easily formed during the nonenzymatic oligomerization of activated nucleotides. They often form ?caps' which terminate an oligonucleotide with a 5'-5' pyrophosphate. Owing to their structural resemblance to the intermediates in enzymatic ligation reactions, it has been suggested that pyrophosphate caps might have been capable of acting as activating groups in chain elongation processes. We argue that an alternative possibility would have been the specific hydrolysis of pyrophosphates. Author (Herner)

A95-72552
PEPTIDE NUCLEIC ACID (PNA): A MODEL STRUCTURE FOR THE PRIMORDIAL GENETIC MATERIAL?
PETER EGIL NIELSEN Panum Inst., Copenhagen, Denmark Origins of Life and Evolution of the Biosphere (ISSN 0169-6149) vol. 23, no. 5-6 December 1993 p. 323-327
(HTN-95-A0481) Copyright

It is proposed that the primordial genetic material could have been peptide nucleic acids, i.e., DNA analogs having a peptide backbone. PNA monomers based on the amino acid, alpha, gamma-diaminobutyric acid or ornithine are suggested as compounds that could have been formed in the prebiotic soup. Finally, the possibility of a PNA/RNA world is presented, in which PNA constitutes the stable genetic material, while RNA which may be polymerized using the PNA as template accounts for enzymatic activities including PNA replication. Author (Herner)

A95-72553* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE RNA-WORLD AND CO-EVOLUTION HYPOTHESIS AND THE ORIGIN OF LIFE: IMPLICATIONS, RESEARCH STRATEGIES AND PERSPECTIVES
NOAM LAHAV Hebrew Univ. of Jerusalem, Jerusalem, Israel Origins of Life and Evolution of the Biosphere (ISSN 0169-6149) vol. 23, no. 5-6 December 1993 p. 329-344 Research sponsored by NASA. Ames Research Center and Molecular Research Inst.
(HTN-95-A0482) Copyright

The applicability of the RNA-world and co-evolution hypothesis to the study of the very first stages of the origin of life is discussed. The discussion focuses on the basic differences between the two hypotheses and their implications, with regard to the reconstruction methodology, ribosome emergence, balance between ribozymes and protein enzymes, and their major difficultites. Additional complexities of the two hypotheses, such as membranes and the energy source of the first reactions, are not treated in the present work. A central element in the proposed experimental strategies is the study of the catalytic activites of very small peptides and RNA-like oligomers, according to existing, as well as to yet-to-be-invented scenarios of the two hypothesis under consideration. It is suggested that the novel directed molecular evolution technology, and molecular computational modeling, can be applied to this research. This strategy is assumed to be essential for the suggested goal of future studies of the origin of life, namely, the establishment of a 'Primordial Darwinian entity'. Author (Herner)

A95-72554
THE EVOLUTIONARY CHANGE OF THE GENETIC CODE AS RESTRICTED BY THE ANTICODON AND IDENTITY OF TRANSFER RNA
TAKUYA UEDA Tokyo Univ., Tokyo, Japan and KIMITSUNA WATANABE Tokyo Univ., Tokyo, Japan Origins of Life and Evolution of the Biosphere (ISSN 0169-6149) vol. 23, no. 5-6 December 1993 p. 345-364
(HTN-95-A0483) Copyright

The discovery of non-universal genetic codes in several mitochondria and nuclear systems during the past ten years has necessitated a reconsideration of the concept that the genetic code is universal and frozen, as was once believed. Here, the flexibility of the relationship between codons and amino acids is discussed on the basis of the distribution of non-universal genetic codes in various organsims insofar as has been observed to date. Judging from the result of recent investigations into tRNA identity, it would appear that the non-participation of the anticodon in recognition by aminoacyl-tRNA synthesis has significantly influenced the variability of codons. Author (Herner)

A95-72555* National Aeronautics and Space Administration, Washington, DC.
EXPERIMENTAL INVESTIGATION OF AN RNA SEQUENCE SPACE
YOUN-HYUNG LEE Houston Univ., Houston, TX, US, LISA DSOUZA Houston Univ., Houston, TX, US, and GEORGE E. FOX Houston Univ., Houston, TX, US Origins of Life and Evolution of the Biosphere (ISSN 0169-6149) vol. 23, no. 5-6 December 1993 p. 365-372 Research sponsored by Whitehall Foundation
(Contract(s)/Grant(s): NAGW-2198)
(HTN-95-A0484) Copyright

Modern rRNAs are the historic consequence of an ongoing evolutionary exploration of a sequence space. These extant sequences belong to a special subset of the sequence space that is comprised only of those primary sequences that can validly perform the biological function(s) required of the particular RNA. If it were possible to readily identify all such valid sequences, stochastic predictions could be made about the relative likelihood of various evolutionary pathways available to an RNA. Herein an experimental system which can assess whether a particular sequence is likely to have validity as a eubacterial 5S rRNA is described. A total of ten naturally occurring, and hence known to be valid, sequences and two point mutants of unknown validity were used to test the usefulness of the approach. Nine of the ten valid sequences tested positive whereas both mutants tested as clearly defective. The tenth valid sequence gave results that would be interpreted as reflecting a borderline status were the answer not known. These results demonstrate that it is possible to experimentally determine which sequences in local regions of the sequence space are potentially valid 5S rRNAs. Author (Herner)

A95-72556
RNA BASED EVOLUTIONARY OPTIMIZATION

PETER SCHUSTER Inst. fuer Molekulare Biotechnologie, Jena, Germany Origins of Life and Evolution of the Biosphere (ISSN 0169-6149) vol. 23, no. 5-6 December 1993 p. 373-391
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(HTN-95-A0485) Copyright

The notion of an RNA world has been introduced for a prebiotic scenario that is dominated by RNA molecules and their properties, in particular their capabilities to act as templates for reproduction and as catalysts for several cleavage and ligation reactions of polynucleotides and polypeptides. Error-propagation in RNA replication leads to formation of mutant spectra called 'quasispecies'. Evolution of RNA molecules can be studied and interpreted by considering secondary structures. The notion of sequence space introduces a distance between pairs of RNA sequences which is tantamount to counting the minimal number of point mutations required to convert the sequences into each other. The mean sensitivity of RNA secondary to mutation depends strongly on the base pairing alphabet: structures from sequences which contain only one base pair (GC or AU are much less stable against mutation than those derived from the natural (AUGC) sequences).
Author (revised by Herner)

A95-72557
ON CONCERNED ORIGIN OF TRANSFER RNAS WITH COMPLEMENTARY ANTICODONS
SERGEI RODIN Russian Academy of Sciences, Novosibirsk, Russia, SUSUMU OHNO Beckman Research Inst. of the City of Hope, Duarte, CA, US, and ANDREI RODIN Texas Univ., Houston, TX, US Origins of Life and Evolution of the Biosphere (ISSN 0169-6149) vol. 23, no. 5-6 December 1993 p. 393-418 Research sponsored by Consejo Nacional de Ciencia y Technologia and Inst. de Fisica
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Pairs of antiparallely oriented consensus tRNAs with complementary anticodon stem and loop region. Even smaller such complementary distances are shown by illegitimately complementary antocodons, i.e. those with allowed pairing between G and U bases. Accordingly, we suppose that transfer RNAs have emerged concertedly as complementary strands of primordial double helix-like RNA molecules. Replication of such molecules with illegitimately complementary antocodons might generate new synonymous codons for the same pair of amino acids. Logically, the idea of tRNA concerted origin dictates very ancient establishment of direct links between anticodons and the type of amino acids with which pre-tRNAs were to be charged. More specifically, anticodons (first of all, the 2nd base) could selectively target 'their' amino acids, reaction of acylating itself being performed by another non-specific site of pre-tRNA or even by another ribozyme. In all, the above findings and speculations are consistent to the hypercyclic concept (Eigen and Schuster, 1979), and throw new light on the genetic code origin and associated problems. Also favoring this idea are data on complementary codon usage patterns in different genomes. Author (Herner)

A95-72558* National Aeronautics and Space Administration, Washington, DC.
APPLICABILITY OF PM3 TO TRANSPHOSPHORYLATION REACTION PATH: TOWARD DESIGNING A MINIMAL RIBOZYME
JOHN I. MANCHESTER Roswell Park Cancer Inst., Buffalo, NY, US, MASAYUKI SHIBATA Roswell Park Cancer Inst., Buffalo, NY, US, ROBERT F. SETLIK Roswell Park Cancer Inst., Buffalo, NY, US, RICK L. ORNSTEIN Battelle Pacific Northwest Lab., Richland, WA, US, and ROBERT REIN Roswell Park Cancer Inst., Buffalo, NY, US Origins of Life and Evolution of the Biosphere (ISSN 0169-6149) vol. 23, no. 5-6 December 1993 p. 419-427 Research sponsored by National Foundation for Cancer Research and Northwest Coll. and Univ. Association for Science
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A growing body of evidence shows that RNA can catalyze many of the reactions necessary both for replication of genetic material and the possible transition into the modern protein-based world. However, contemporary ribozymes are too large to have self-assembled from a prebiotic oligonucleotide pool. Still, it is likely that the major features of the earliest ribozymes have been preserved as molecular fossils in the catalytic RNA of today. Therefore, the search for a minimal ribozyme has been aimed at finding the necessary structural features of a modern ribozyme (Beaudry and Joyce, 1990). Both a three-dimensional model and quantum chemical calculations are required to quantitatively determine the effects of structural features of the ribozyme on the reaction it catalyzes. Using this model, quantum chemical calculations must be performed to determine quantitatively the effects of structural features on catalysis. Previous studies of the reaction path have been conducted at the ab initio level, but these methods are limited to small models due to enormous computational requirements. Semiempirical methods have been applied to large systems in the past; however, the accuracy of these methods depends largely on a simple model of the ribozyme-catalyzed reaction, or hydrolysis of phosphoric acid. We find that the results are qualitatively similar to ab initio results using large basis sets. Therefore, PM3 is suitable for studying the reaction path of the ribozyme-catalyzed reaction. Author (Herner)

A95-73036
EFFECT OF HYPERBARIC OXYGEN ON TISSUE DISTRIBUTION OF MONONUCLEAR CELL SUBSETS IN THE RAT
N. BITTERMAN Israel Naval Medical Inst., Haifa, Israel, N. LAHAT Israel Naval Medical Inst., Haifa, Israel, T. ROSENWALD Israel Naval Medical Inst., Haifa, Israel, A. KINARTY Israel Naval Medical Inst., Haifa, Israel, Y. MELAMED Israel Naval Medical Inst., Haifa, Israel, and H. BITTERMAN Israel Naval Medical Inst., Haifa, Israel Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2355-2359
(HTN-95-50846) Copyright

In a previous study we found a significant temporary decrease in the ratio of CD4/CD8 (helper, inducer/suppressor, cytotoxic) T lymphocytes in the peripheral blood of healthy hman volunteers after exposure to a single commonly used profile of hyperbaric oxygen (HBO). The transient nature of the changes suggested redistribution of T-cell subsets. The purpose of the present study was to verify such a redistribution and to locate possible target organs in an animal model. A single exposure of rats to HBO (0.28 MPa) induced a highly significant rapid decrease in the CD4/CD8 ratio in peripheral blood count, confirming our previous findings in humans. HBO also induced a significant increase in the CD4/CD8 ratio in the lungs and lymph nodes and a significant decrease in the ratio in the spleen. Furthermore, exposure to HBO induced a significant increase in T cells bearing surface interleukin-2 receptors in the blood, spleen, lungs, and lymph glands and a significant decrease in T cells expressing alpha beta-receptors in the lungs and lymph glands. Our findings suggest rapid T-cell activation after a brief exposure to HBO, with shifts of CD4 and CD8 subsets and variations in T-cell receptor type. These rapid changes in the parameters of cell-mediated immunity may represent the activation of protective mechanisms against the toxic effect of oxygen or the early stages of pulmonary oxygen toxicity. Author (Herner)

A95-73037
ELECTRICALLY EVOKED MYOELECTRIC SIGNALS IN BACK MUSCLES: EFFECT OF SIDE DOMINANCE
ROBERTO MERLETTI Boston Univ., Boston, MA, US, CARLO J. DE LUCA Boston Univ., Boston, MA, US, and DEEPA SATHYAN Boston Univ., Boston, MA, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2104-2114 Research sponsored by the Dept. of Veterans Affairs and Liberty Mutual Insurance Co.
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This work had two goals, to study the effect of hand dominance on myoelectric signal variables and fatigue indexes in back muscles

and to assess the repeatability of the estimates of such variables. Myoelectric manifestations of musle fatigue were studied in the right and left longissimus dorsi muscles of five right-handed and five left-handed normal male subjects. Myoelectric signals (M waves), evoked by stimulation applied to a muscle's motor point, were detected with surface electrodes. Each test consisted of eliciting a tetanic contraction of 30 s duration with supramaximal stimulation at 25 Hz and was repeated five times on 5 different days for each subject. The mean and median frequencies of the resulting power spectra of the M waves were plotted vs. time, and fatigue indexes were obtained from the time course of these variables. Only two-thirds of the elicited contractions provided signals of sufficiently good quality to obtain reliable estimates of the mean and median frequencies. Criteria for acceptability are described. Analysis of variance and paired comparisons showed a statistically significant effect of side dominance on fatigue indexes in the right-handed subjects but not in the left-handed subjects. Normalized initial slope and other fatigue indexes based on spectral variables demonstrated myoelectric manifestations of fatigue that were greater on the dominant side. We surmise that the differences are related to the fiber type modifications associated with the unilateral usage of the upper limbs and the consequent activation of the nondominant side of the back. Author (Hemer)

A95-73038
DECREASING STIMULATION FREQUENCY-DEPENDENT LENGTH-FORCE CHARACTERISTICS OF RAT MUSCLE

BORIS ROSZEK Vrije Univ., Amsterdam, Netherlands, GUUS C. BAAN Vrije Univ., Amsterdam, Netherlands, and PETER A. HUIJING Vrije Univ., Amsterdam, Netherlands Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2115-2124

Effects of decreasing stimulation frequency on length-force characteristics were determined for rat medial gastrocnemius muscle. The peripheral nerve was stimulated supramaximally with a succession of twitch and frequencies of 100, 50, 40, 30, and 15 Hz. Active peak tetanic and twitch forces and active muscle geometry were analyzed. Optimal muscle length and active slack length shifted significantly to higher muscle length by a maximum of 2.8 and 3.2 mm, respectively. Further significant effects were found for distal fiber length and mean sarcomere length of distal fiber (increases) and for fiber angle and aponeurosis length (decreases). Neither muscle length range between active slack and optimal length nor aponeurosis angle was altered significantly. We concluded that decreasing stimulation frequency-dependent length-force characteristics are affected by a complex interaction of length-dependent calcium sensitivity, potentiation of the contractile system, distribution of sarcomere length, and interactions between force exerted and aponeurosis length. Length-dependent calcium sensitivity seems to be a major factor determining the magnitude of the shift of optimal muscle length. Author (Hemer)

A95-73039
SEX DIFFERENCES IN SURFACE ELECTROMYOGRAM (EMG) INTERFERENCE PATTERN POWER SPECTRUM

R. CIONI Univ. of Siena, Siena, Italy, F. GIANNINI Univ. of Siena, Siena, Italy, C. PARADISO Univ. of Siena, Siena, Italy, N. BATTISTINI Univ. of Siena, Siena, Italy, C. NAVONA Univ. of Siena, Siena, Italy, and A. STARITA Univ. of Siena, Siena, Italy Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2163-2168

Sex differences in the spectral parameters of the surface electromyogram (EMG) power spectrum were studied during voluntary muscle contractions of different strength with rest in between. The influence of two different types of leads (unipolar and bipolar) on the values of the spectral parameters was also investigated under the same experimental conditions. The subjects were 15 healthy female and 15 healthy male volunteers. The relationship between the amplitude (root mean square) of the EMG and the force developed was not linear. The mean values of the median power frequency were lower in women than in men. With both types of lead, the increase in force was accompanied by a progressive increase in median power frequency in male and female subjects. The significant differences in spectral parameters observed in the two sexes are probably correlated with anatomic differences. Author (Hemer)

A95-73040
CHANGES IN POTENTIAL CONTROLLERS OF HUMAN SKELETAL MUSCLE RESPIRATION DURING INCREMENTAL CALF EXERCISE

THOMAS J. BARSTOW Harbor-Univ. of Cal. at Los Angeles Medical Center, Torrance, CA, US, STEVEN D. BUCHTHAL Harbor-Univ. of Cal. at Los Angeles Medical Center, Torrance, CA, US, STEFANIA ZANCONATO Harbor-Univ. of Cal. at Los Angeles Medical Center, Torrance, CA, US, and DAN M. COOPER Harbor-Univ. of Cal. at Los Angeles Medical Center, Torrance, CA, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2169-2176 Research sponsored by National Heart, Lung, and Blood Inst. and Harbor-Univ. of Cal. at Los Angeles Medical Center

The purpose of this study was to evaluate the consequences of nonlinear changes in phosphocreatine (PCr) and pH during incremental calf exercise on estimates of ADP and cytosolic free energy of ATP hydrolysis (delta G(sub ATP)). Six subjects performed incremental plantar flexion exercise on a treadle ergometer while muscle P(sub i) metabolism (PCr, P(sub i), ATP) and pH were followed using P-31-nuclear magnetic resonance spectroscopy. Changes in ADP and deta G(sub ATP) were estimated with the assumption that there was equilibrium of the creatine kinase reaction and homogeneous tissue metabolite pools. All six subjects showed a threshold for onset of cellular acidosis that occurred on a average at 47.3 +/- 12.7% of peak work rate (PWR). In five of the six subjects, PCr and P(sub i) showed accelerated rates of change above the threshold for onset of cellular acidosis. In all six subjects, ADP, when correctly calculated considering changes in pH, rose in a curvilinear fashion that was well described by a Michaelis-Menten hyperbola through 60-100% of PWR, with a mean apparent Michaelis-Menten constant of 43.1 +/- 17.1 micro-M ADP and a predicted maximal oxidative rate at PCr = 0, which was 241 +/- 94% of PWR. Delta G(sub ATP) rose linearly with work rate from -62.9 +/- 1.8 kJ/mol during unloaded treadling to -55.0 +/- 1.8 kJ/mol at PWR. If we assume a linear O2 uptake-to-work rate relationship, these results are most consistent with control of respiration being exerted through delta G(sub ATP) under these conditions (incremental exercise by human calf muscle). These data suggest that the changes in PCr (and ultimately changes in ADP as well) with increasing work rate reflect shifts in substrate concentrations that are dictated and/or required under changing acid-base conditions by the linear rise in delta G(sub ATP). Author (Hemer)

A95-73041
EXERCISE-INDUCED OXIDATIVE STRESS: GLUTATHIONE SUPPLEMENTATION AND DEFICIENCY

CHANDAN K. SEN Univ. of Kuopio, Kuopio, Finland, MUSTAFA ATALAY Univ. of Kuopio, Kuopio, Finland, and OSMO HANNINEN Univ. of Kuopio, Kuopio, Finland Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2177-2187 Research sponsored by the Section on Exercise Medicine, Finish Ministry of Education; Juho Vainio Foundation, Helsinki; and Univ. of Kuopio

Glutathione (GSH) plays a central role in coordinating the synergism between different lipid- and aqueous-phase antioxidants. We documented (1) how exogenous GSH and N-ace-tylcysteine (NAC) may affect exhaustive exercise-induced changes in tissue GSH status, lipid peroxides (thiobarbituric acid-reactive substances (TBARS)), and endurance and (2) the relative role of endogenous GSH in the cricumvention of exercise-induced oxidative stress by using GSH-deficient (L-buthionine-(S, R)-sulfoximine (BSO)-treated) rats. Intraperitoneal injection of GSH remarkably increased plasma GSH; exogenous GSH per se was an ineffective delivery agent of

GSH to tissues. Repeated administration of GSH (1 time/day for 3 days) increased blood and kidney total GSH (TGSH; GSH + oxidized GSH (GSSG)). Neither GSH nor NAC influenced endurance to exhaustion. NAC decreased exercise-induced GSH oxidation in the lung and blood. BSO decreased TGSH pools in the liver, lung, blood, and plasma by approximately 50% and in skeletal muscle and heart by 80-90%. Compared with control, resting GSH-deficient rats had lower GSSG in the liver, red gastrocnemius muscle, heart and blood; similar GSSG/TGSH ratios in the liver, heart, lung, blood, and plasma; higher GSSG/TGSH ratios in the skeletal muscle; and more TBARS in skeletal muscle, heart, and plasma. In contrast to control, exhaustive exercise of GSH-deficient rats did not decrease TGSH in the liver, muscle, or heart or increase TGSH of plasma; GSSG of muscle, blood, or plasma; or TBARS of plasma or muscle. GSH-deficient rats had approximately 50% reduced endurance, which suggests a critical role of endogenous GSH in the circumvention of exercise-induced oxidative stress and as a determinant of exercise performance. Author (Herner)

A95-73042
SKELETAL MUSCLE PH ASSESSED BY BIOCHEMICAL AND P-31-MRS METHODS DURING EXERCISE AND RECOVERY IN MEN

MARTIN J. SULLIVAN Duke Univ., Durham, NC, US, BENGT SALTIN Duke Univ., Durham, NC, US, ROSA NEGRO-VILAR Duke Univ., Durham, NC, US, BRIAN D. DUSCHA Duke Univ., Durham, NC, US, and H. CECIL CHARLES Duke Univ., Durham, NC, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2194-2200 Research sponsored by National Heart, Lung, and Blood Inst.; the Veterans Affairs Medical Center; National Inst. of Health Division of Research Resources, General Clinical Research Centers; and the American Heart Association
(HTN-95-50852)

The present study was designed to compare evaluation of skeletal muscle metabolism (vastus lateralis) evaluated by P-31-magnetic resonance spectroscopy (MRS) and biochemical analysis. During identical isometric knee extensor exercise protocols to fatigue in eight men, biopsy samples were taken at rest, peak exercise, and 32 s postexercise and P-31-MRS data were collected continuously for phosphocreatine (PCr), pH, ATP, and P(sub i) at 8- or 32-s intervals. There was no difference in ATP or pH measurements between the two techniques at rest, during peak exercise, or in recovery. Corresponding measurements of pH by the two techniques were closely related, and pH measured by P-31-MRS was closely related to muscle lactate accumulation. The level of PCr at peak exercise, expressed as a percentage of the baseline value, was not different between the two techniques. The results indicate that, in skeletal muscle in normal subjects, (1) measurements of pH and PCr at rest and during exercise do not differ between the P-31-MRS and biopsy techniques and (2) muscle pH measured by P-31-MRS is closely related to lactate accumulation in men. Our data suggest that direct comparison of results of studies of exercise metabolism using these two techniques is warranted. Author (Herner)

A95-73043
ADVERSE EFFECT OF HYPERINFLATION ON PARASTERNAL INTERCOSTALS

VINCENT NINANE Erasme Univ. Hospital, Brussels, Belgium and MASSIMO GORINI Erasme Univ. Hospital, Brussels, Belgium Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2201-2206 Research sponsored by the Fonds National de la Recherche Scientifique, Belgium, and the Fondazione Pro Juventute Don C. Gnocchi, Florence, Italy
(HTN-95-50853)

In the present studies, we assessed whether the ability of these muscles to expand the rib cage and inflate the lungs is really maintained. We thus measured the electromyogram and the changes in length of these muscles, the axial motion of the sternum and the ribs, and the changes in pleural pressure and tidal volume in anesthetized vagotomized phrenicotomized dogs during selective parasternal stimulation and during spontaneous breathing at different lung volumes corresponding to 0, 5, 10, and 15 cmH2O positive airway pressure. Compared with functional residual capacity, parasternal stimulation at 15 cmH2O positive airway pressure caused a mild decrease in muscle shortening, a large reduction in cranial rib motion, and a large reduction in pleural pressure fall. The caudal displacement of the sternum, however, was increased. Similar alterations in rib and sternal motions and in muscle shortening were seen during spontaneous breathing; tidal volume was markedly reduced as well. These observation thus indicate that hyperinflation affects the action of the parasternal intercostals on the rib cage; their rib-elevating action is decreased, whereas their action on the sternum is increased. As a result, their ability to inflate the lung is reduced. Thus, the inflationary actions of both the diaphragm and parasternal intercostals are reduced by hyperinflation. Author (Herner)

A95-73044
EFFECTS OF ACUTE AND CHRONIC MATERNAL EXERCISE ON FETAL HEART RATE

KATHERINE A. WEBB Queen's Univ., Ontario, Canada, LARRY A. WOLFE Queen's Univ., Ontario, Canada, and MICHAEL J. MCGRATH Queen's Univ., Ontario, Canada Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2207-2213 Research sponsored by Queen's Univ., Fitness Canada, Canadian Fitness and Lifestyle Research Inst., and Ontario Ministry of Health
(HTN-95-50854)

Maternal-fetal effects of cycle ergometer conditioning (heart rate of 145 beats/min at 25 min/day for 3 days/wk) were studied during the second and third pregnancy trimesters. Subjects were 22 previously sedentary women and 16 nonexercising pregnant control women. Fetal heart rate (FHR) characteristics were studied before, during, and after 15 min of upright cycling at a maternal heart rate target of 145 beats/min at the end of both the second and third trimesters. Despite higher cycling power outputs in the exercised group, mean FHR responses were similar in both groups and conformed to (1) gradual increase in FHR baseline during exercise, (2) normal variability, and (3) normal reactivity. Fetal bradycardia was observed during (n = 1) and after (n = 2) exercise in three isolated tests. The timing of these events suggested that the likelihood of significant fetal hypoxia is highest in the immediate postexercise period. These results also support the hypothesis that physically conditioned women can performed at higher exercise power outputs than sedentary women without inducing fetal hypoxic stress. Further study is recommended to examine possible fetal and placental adaptations to maternal aerobic conditioning. Author (Herner)

A95-73045
VITAMIN E DOES NOT PREVENT EXERCISE-INDUCED INCREASE IN PULMONARY CLEARANCE

A. M. LORINO Inst. Nat. de la Sante et de la Recherche Med. Unite, Creteil, France, M. PAUL Inst. Nat. de la Sante et de la Recherche Med. Unite, Creteil, France, L. COCEA Inst. Nat. de la Sante et de la Recherche Med. Unite, Creteil, France, M. SCHERRER-CROSBIE Inst. Nat. de la Sante et de la Recherche Med. Unite, Creteil, France, E. DAHAN Inst. Nat. de la Sante et de la Recherche Med. Unite, Creteil, France, M. MEIGNAN Inst. Nat. de la Sante et de la Recherche Med. Unite, Creteil, France, and G. ATLAN Inst. Nat. de la Sante et de la Recherche Med. Unite, Creteil, France Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2219-2223
(HTN-95-50855)

It has been observed that sustained exercise results in a prolonged increase in alveolar epithelial permeability, as assessed by the pulmonary clearance rate of aerosolized Tc-99m-labeled diethylenetriaminepenta acetate (Lorino et al. J. Appl. Physiol. 67: 2055-2059, 1989). The involvement of lipid peroxidation in this increased permeability was tested in seven nonsmoking volunteers by comparing the exercise-induced increases in pulmonary Tc-99m diethylenetriaminepenta acetate clearance before and after a 3-wk supplementation with oral vitamin E (1,000 IU/day), according to a protocol designed as a single-blind crossover study. The 60-min exercise was performed on a treadmill at a constant load corresponding

to 80% of maximal O2 uptake. Administration of vitamin E, a very important antioxidant, did not reduce the exercise-induced increase in lung clearance, suggesting that the exercise-induced increase in lung epithelial permeability does not primarily result from the occurrence of lipid peroxidation in the aveolar membrane. This result thus corroborates the hypothesis of an alteration of the intercellular tight junctions due to the mechanical effects of hyperventilation. Author (Herner)

A95-73046
DIAPHRAGMATIC PRESSURE-FLOW RELATIONSHIP DURING HEMORRHAGIC SHOCK: ROLE OF NITRIC OXIDE
MICHAEL E. WARD Royal Victoria Hospital, Montreal, Canada and SABAH N. A. HUSSAIN Royal Victoria Hospital, Montreal, Canada Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2244-2249 Research sponsored by the Medical Research Council of Canada and the Canadian Heart and Stroke Foundation
(HTN-95-50856)

In the vascularly isolated resting and contracting (3 Hz) canine hemidiaphragm, we studied the effect of intra-arterial infusion of the nitric oxide (NO) inhibitor N(sup G)-nitro-L-arginine (LNA) on the relationship between phrenic arterial perfusion pressure (Pphr) and blood flow (Qphr). In separate groups of animals, either saline or LNA was infused into the phrenic artery over 20 min. The diaphragm was then autoperfused by diverting flow from the left femoral artery. Arterial blood pressure was reduced in stages by controlled hemorrhage. The Pphr-to-Qphr relationship was plotted for each animal, and the third-order polynomial of best fit was determined by least squares regression. The inflection point of this relationship was determined for each animal. In the contracting and resting diaphragms, the inflection point corresponded to Pphr values of 83.6 +/- 4.7 and 72.5 +/- 6.8 mmHg, respectively, in the saline-treated group compared with 86.2 +/- 2.7 and 76.8 +/-5.1 mmHg, respectively, in the LNA-treated group. In the contracting diaphragm, LNA reduced Qphr uniformly across the entire range of perfusion pressures. In the resting diaphragm, the effect of LNA was not uniform. At perfusion pressures below the inflection point, the flow was reduced in proportion to the reduction in inflection point flow. At higher perfusion pressures, Qphr was decreased to a greater extent than could be accounted for by the change in inflection point flow. In the resting muscle, increased NO release acts to counterbalance myogenic vasoconstriction at high perfusion pressures. When the muscle is contracting, changes in NO release are of little importance in this regard, possibly because of increased availability of other metabolic vasodilator substances. Author (Herner)

A95-73047
HISTOCHEMICAL AND MECHANICAL PROPERTIES OF DIAPHRAGM MUSCLE IN MORBIDLY OBESE ZUCKER RATS
GASPAR A. FARKAS Thoracic Disease and Anesthesiology Research Units, Rochester, MN, US, LUC E. GOSSELIN Thoracic Disease and Anesthesiology Research Units, Rochester, MN, US, WEN-ZHI ZHAN Thoracic Disease and Anesthesiology Research Units, Rochester, MN, US, EVELYN H. SCHLENKER Thoracic Disease and Anesthesiology Research Units, Rochester, MN, US, and GARY C. SIECK Thoracic Disease and Anesthesiology Research Units, Rochester, MN, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2250-2259 Research sponsored by National Heart, Lung, and Blood Inst. and the Mayo Foundation
(HTN-95-50857)

The purpose of the present study was to evaluate the effects of chronic mass loading produced by obesity on the structural and functional characteristics of the diaphragm in lean and obese Zucker rats. The trapezius muscle served as an internal control. The studies were carried out on 17 lean and 16 obese Zucker rats. We observed that the diaphragms from obese animals were restructured such that the overall contribution of type I and IIa fibers was significantly increased. As a consequence of this remodeling, overall diaphragm thickness was selectively greater in obese animals. In small isolated diaphragm bundles studied in vitro, we also detected a reduction in specific force in obese animals that was not detected in the trapezius muscle. In vitro fatigue resistance, assessed by repeated stimulation, was similar in muscles of lean and obese animals. Diaphragm fiber oxidative capacity (succinate dehydrogenase activity) was also comparable in lean and obese animals. We conclude that in obesity the diaphragm undergoes modest remodeling that may be beneficial in enhancing force generation. Author (Herner)

A95-73048
EFFECTS OF ALTERED MUSCLE ACTIVATION ON OXIDATION ENZYME ACTIVITY IN RAT ALPHA-MOTONEURONS
KEVIN SEBURN Univ. de Montreal, Montreal, Quebec, Canada, CARL COICOU Univ. de Montreal, Montreal, Quebec, Canada, and PHILLIP GARDINER Univ. de Montreal, Montreal, Quebec, Canada Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2269-2274 Research sponsored by NSERC
(HTN-95-50858)

Some controversy exists as to whether alpha-motoneurons adapt their oxidative metabolism to changes in chronic activity levels and to altered status of their end organs, as occurs in other neuron types in the central nervous system. We measured, using a personal computer-based image analysis system, succinate dehydrogenase (SDH) activity in rat hindlimb motoneurons under conditions of increased activity (daily voluntary exercise plus treadmill endurance training, the latter 2 h/day, 4 days/wk, for 12 wk) and in a condition of muscle disuse (tetrodotoxin-induced paralysis for 2 wk) in which muscle oxidative enzymes are reduced. Although exercise-trained medial gastrocnemius showed significant adaptations (increased mean SDH activity of type I and increased proportion and total SDH activity of type I and combined I + IIa fibers), SDH activity of innervating motoneurons (identified by retrograde tracing using fast blue) was unchanged. In addition, tetrodotoxin-induced disuse, which results in hindlimb atrophy and SDH decreases (30% decrease measured in medial gastrocnemius muscle homogenates), failed to alter soma SDH or size in unspecified lumbar motoneurons. These results, obtained over a wider range of activity levels than in previous reports, suggest that the oxidative enzymes of motoneurons do not change despite clear adaptations in the muscles they innervate. Author (Herner)

A95-73049
EFFECTS OF MAXIMAL EXERCISE AND VENOUS OCCLUSION ON FIBRINOLYTIC ACTIVITY IN PHYSICALLY ACTIVE AND INACTIVE MEN
LINDA M. SZYMANSKI Univ. of South Carolina, Columbia, SC, US, RUSSELL R. PATE Univ. of South Carolina, Columbia, SC, US, and J. LARRY DURSTINE Univ. of South Carolina, Columbia, SC, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2305-2310 Research sponsored by the American Heart Association and the Scientific Research Society
(HTN-95-50859)

The purposes of this study were to (1) characterize changes in fibrinolytic activity in response to maximal exercise and 5-min venous occlusion and (2) compare responses in men of various habitual physical activity levels. Tissue plasminogen activator (TPA) activity and plasminogen activator inhibitor 1 (PAI-1) activity were measured in 15 inactive, 15 regularly active, and 15 highly active men. Data were analyzed using a three-way analysis of variance with repeated measures. Pretest TPA activity was similar among groups. TPA activity increased postexercise with higher values seen in the active groups. The highly active group also significantly increased TPA activity postvenous occlusion. Pretest PAI-1 activity was different among groups, with the inactive group showing the highest activity and the highly active group the lowest. PAI-1 activity decreased with exercise but did not change with venous occlusion. In conclusion, active men exhibited greater changes in fibrinolytic activity with maximal exercise and venous occlusion than inactive

men. This enhanced fibrinolytic activity may be an important mechanism mediating the cardioprotective effect provided by regular physical activity. Author (Herner)

A95-73050
LONGITUDINAL DEVELOPMENT OF YOUNG TALENTED SPEED SKATERS: PHYSIOLOGICAL AND ANTHROPOMETRIC ASPECTS
J. J. DE KONING Vrije Univ., Amsterdam, Netherlands, F. C. BAKKER Vrije Univ., Amsterdam, Netherlands, G. DE GROOT Vrije Univ., Amsterdam, Netherlands, and G. J. VAN INGEN SCHENAU Vrije Univ., Amsterdam, Netherlands Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2311-2317
(HTN-95-50860) Copyright

A longitudinal analysis of a group of speed skaters was done to identify the performance-determining factors for a successful speed skating career. This paper presents both the physiological and anthropometric results of this longitudinal study. Twenty-four athletes from the Dutch National Junior Speed Skating Team were followed from age 16-17 yr to age 20-21 yr. During the development from junior to senior speed skater, a number of anthropometric and physiological variables changed. There were no differences between successful and unsuccessful speed skaters from an anthropometric perspective; consequently, it was not possible to distinguish successful from unsuccessful athletes on anthropometric grounds. The longitudinal data showed that at a younger age the successful speed skaters had similar oxygen consumption, mechanical efficiency, and power output values compared with the unsuccessful speed skaters. Later in the study, successful speed skaters distinguished themselves by the ability to produce higher power output values. There were no anthropometric or physiological relationships found in this study on which performance at the age of 20-21 yr could be predicted with measurements at a junior age. Author (Herner)

A95-73051
BLOOD LACTATE AND ACID-BASE BALANCE IN GRADED NEONATAL HYPOXIA: EVIDENCE FOR OXYGEN-RESTRICTED METABOLISM
SHONA M. TORRANCE Univ. of Toronto, Toronto, Ontario, Canada and CARIN WITTNICH Univ. of Toronto, Toronto, Ontario, Canada Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2318-2324 Research sponsored by the Heart and Stroke Foundation of Ontario
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This study examines the neonatal response to graded hypoxia and determines the arterial PO2 (PAO2) threshold for oxygen-restricted metabolism as confirmed by the development of lactic acidosis and altered oxygen handling. Anesthetized, intubated, and ventilated 3-day-old pigs (n = 56) were randomly assigned to one of five predetermined acute (120 min) graded hypoxia groups: normoxia (PaO2 = 80 Torr) or mild (60 Torr), moderate (40 Torr), moderately severe (30 Torr), or severe (20 Torr) hypoxia. In moderate hypoxia, lactate and acid-base homeostasis were unaltered due to a significant increase in oxygen extraction that was sufficient to maintain the arteriovenous oxygen content difference (oxygen uptake). In moderately severe hypoxia, increased arterial lactate and decreased HCO3(-) and base excess were evidence of anaerobic metabolism, yet pH was unaltered, indicating adequate buffering. In this group, despite the increase in oxygen extraction, oxygen uptake was reduced, indicating the onset of oxygen-restricted metabolism. The severe hypoxia group had significantly increased lactate, decreased pH and base excess, and depletion of HCO3(-). Here, increases in oxygen extraction were severely limited by availability, resulting in significantly reduced oxygen uptake, anaerobic metabolism, and profound lactic acidosis. Author (Herner)

A95-73052
EFFECT OF MUSCULAR EXERCISE ON CHRONIC RELAPSING EXPERIMENTAL AUTOIMMUNE ENCEPHALOMYELITIS
CHRISTINE LE PAGE Univ. Paris, Paris, France, ARNAUD FERRY Univ. Paris, Paris, France, and MICHEL RIEU Univ. Paris, Paris, France Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2341-2347 Research sponsored by the Ministere de la Jeunesse et des Sports
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We examined whether physical exercise affected the development of an autoimmune response, experimental autoimmune encephalomyelitis (EAE), which is a demyelinating disease leading to paralysis. EAE was inducted on day 0, in rats of both sexes, by injecting them with spinal cord tissue in adjuvant. From days 1 to 10 after injection, exercised rats (n = 55) ran on a treadmill (60-120 min/day) before the onset of the paralytic disease. Clinical signs of the disease (ataxia, paralysis, and body mass loss) were examined in exercised and control rats (n = 54). Three types of EAE were induced: monophasis, acute, and chronic relapsing (CR)-EAE (3 bouts of disease, CR-EAE 1, 2, and 3, separated by remissions). Exercise significantly delayed the onset of CR-EAE 1 and the 1st day of maximum severity of CR-EAE 1 and CR-EAE 2. Moreover, the duration of CR-EAE 1 was significantly decreased in exercised rats compared with control rats. The peak severity of the different types of EAE was not modified by exercise. The present study indicates that endurance exercise during the phase of induction of EAE diminished lightly only one type of EAE (CR-EAE) and therefore did not exacerbate the autoimmune disease. Author (Herner)

A95-73053
FREE FATTY ACID METABOLISM IN AEROBICALLY FIT INDIVIDUALS
JORGE CALLES-ESCANDON Univ. of Vermont, Burlington, VT, US and PATRICIA DRISCOLL Univ. of Vermont, Burlington, VT, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2374-2379 Research sponsored by National Inst. of Diabetes and Digestive and Kidney Diseases and the American Diabetes Association
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The impact of aerobic fitness level on the production and disposal of serum free fatty acids was investigated in 26 normal young volunteers. The fitness level was ascertained by history and confirmed by determination of maximal aerobic capacity. Energy expenditure and substrate oxidation at rest were measured with indirect calorimetry. Free fatty acid turnover was measured with an infusion of (C-14) palmitic acid. All tests were done equal to or greater than 48 h after the last bout of exercise. The sedentary (SED) volunteers had higher rates of systemic delivery of fatty acids than aerobically fit (FIT) individuals. This difference was accentuated when the values were normalized to fat-free mass. Fatty acid oxidation was similar between FIT and SED volunteers in absolute numbers as well as when normalized to fat-free mass. In constrast, the nonoxidative disposal of serum fatty acids was higher in SED than in FIT individuals. Thus, the ratio of nonoxidative to oxidative disposal rates of fatty acids was higher in SED than in FIT individuals. The data support the hypothesis that high aerobic fitness level is associated with a low rate of systemic delivery of fatty acids at rest. Nevertheless, subjects with high aerobic fitness levels have fat oxidation at the same rate as unfit individuals. Author (Herner)

A95-73054
EFFECTS OF SPRINT CYCLE TRAINING ON HUMAN SKELETAL MUSCLE
CRAIG A. ALLEMEIER Ohio Univ., Athens, OH, US, ANDREW C. FRY Ohio Univ., Athens, OH, US, PETER JOHNSON Ohio Univ., Athens, OH, US, ROBERT S. HIKIDA Ohio Univ., Athens, OH, US, FREDRICK C. HAGERMAN Ohio Univ., Athens, OH, US, and ROBERT S. STARON Ohio Univ., Athens, OH, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2385-2390
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Eleven men sprint trained two to three times per week for 6 wk to investigate possible exercise-induced slow-to-fast fiber type conversions. Six individuals served as constrols. Both groups were tested at the beginning and end of the study to determine an aerobic performance and maximal oxygen consumption. In addition, pre- and postbiopsies

were extracted from the vastus lateralis muscle and were analyzed for fiber type composition, cross-sectional area, and myosin heavy chain (MHC) content. No significant changes were found in anaerobic or aerobic performance variables for either group. Although a trend was found for a decrease in the percentage of type IIb fibers, high-intensity sprint cycle training caused no significant changes in the fiber type distribution or cross-sectional area. However, the training protocol did result in a significant decrease in MHC IIb with a concomitant increase in MHC IIa for the training men. These data appear to support previous investigations that have suggested exercise-induced adaptations within the fast fiber population after various types of training (endurance and strength).

Author (Herner)

A95-73055

EFFECTS OF INFUSED EPINEPHRINE ON SLOW PHASE OF O2 UPTAKE KINETICS DURING HEAVY EXERCISE IN HUMANS

GLENN A. GAESSER Univ. of California, Los Angeles, CA, US, SUSAN A. WARD Univ. of California, Los Angeles, CA, US, VICTOR C. BAUM Univ. of California, Los Angeles, CA, US, and BRIAN J. WHIPP Univ. of California, Los Angeles, CA, US

Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2413-2419 Research sponsored by the Cigarette and Tobacco Surtax Fund of the State of California

We tested the hypothesis that infused epinephrine (Epi) would augment the slow phase of oxygen uptake (VO2) during heavy exercise. Six normal healthy males initially performed a ramp test on a cycle ergometer to estimate the lactate threshold (LT) and determine peak VO2. Each subject then performed two 20-min constant-load tests at a power output calculated to elicit a VO2 equal to estimated LT + 0.2(peak VO2 - estimated LT) under control conditions throughout and with an intravenous infusion of Epi from minutes 10 to 20 at a rate of 100 ng/kg/min. Pulmonary gas exchange variables were determined breath by breath. Arterialized venous blood was repeatedly sampled from the dorsum of the heated hand. Epi infusion elevated plasma Epi concentration but had no effect on plasma norepinephrine or K(+) concentrations. Concentrations of blood lactate and pyruvate were increased, pH was decreased, and base excess became more negative by infusion of Epi. Epi infusion increased CO2 production and the respiratory exchange ratio but had no effect on ventilation or VO2. VO2 increased to the same extent in both control and Epi infusion trials. We therefore conclude that neither Epi nor its associated humoral consequences contribute significantly to the slow phase of VO2 kinetics during heavy exercise. Author (Herner)

A95-73056

CHANGES IN POTASSIUM CONTRACTURES DUE TO SIMULATED WEIGHTLESSNESS IN RAT SOLEUS MUSCLE

AMIR KHAMMARI Unite de Recherche Associee, Nantes, France and JACQUES NOIREAUD Unite de Recherche Associee, Nantes, France

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Some contractile properties of soleus muscle (SOL) fibers isolated from tail-suspended (21 days) rats were compared with those determined in the slow-twitch SOL and the fast-twitch extensor digitorum longus muscle (EDL) of control rats. In SOL from suspended rats, the resting membrane potential and the intracellular Na(+) activity were typical of fast-twitch muscles. The relationship between the amplitude of K(+) contractures and the membrane potential was steeper for control SOL than for control EDL and suspended SOL. The inactivation curve was also shifted to more positive potentials after suspension. In the presence of perchlorate anions, the tension activation curves of control EDL and suspended SOL were similarly shifted to more negative potentials. Thus, in the present study, modifications induced by suspension in SOL, mainly related to changes in the voltage-sensing process involved in the excitation-contraction coupling mechanism, were that the SOL assumed some of the characteristics of fast-twitch muscles.

Author (Herner)

A95-73057

HYPERINFLATION WITH INTRINSIC PEEP AND RESPIRATORY MUSCLE BLOOD FLOW

YASUHIRO KAWAGOE Johns Hopkins Univ., Baltimore, MD, US, SOLBERT PERMUTT Johns Hopkins Univ., Baltimore, MD, US, and HENRY E. FESSLER Johns Hopkins Univ., Baltimore, MD, US

Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2440-2448

Increased end-expiratory lung volume and intrinsic positive end-expiratory pressure (PEEP) are common in obstructive lung disease, especially during exacerbations or exercise. This loads the respiratory muscles and may also stress the circulatory system, causing a reduction or redistribution of cardiac output. We measured the blood flow to respiratory muscles and systemic organs using colored microspheres in 10 spontaneously breathing anesthetized tracheotomized dogs. Flows during baseline breathing (BL) were compared with those during hyperinflation (HI) induced by a mechanical analogue of airway closure and with those during an inspiratory resistive load (IR) that produced an equivalent increase in inspiratory work and time-integrated transdiaphragmatic pressure. Cardiac output was unchanged during IR but was reduced during HI. Among the organs studied, flow was unaltered by IR but decreased to the liver and pancreas and increased to the brain during HI. For the respiratory muscles, flow to the diaphragm increased during IR. However, despite a 1.9-fold increase in inspiratory work per minute and a 2.5-fold increase in integrated transdiaphragmatic pressure during HI, blood flow to the diaphragm was unchanged and flow to the scalenes and sternomastoid fell. The only respiratory muscle to which flow increased during HI was the transversus abdominis, an expiratory muscle. We conclude that the circulatory effects of hyperinflation in this model impair inspiratory muscle perfusion and speculate that this may contribute to respiratory muscle dysfunction in hyperinflated states. Author (Herner)

A95-73058

A SIMPLE ISOKINETIC CYCLE FOR MEASUREMENT OF LEG MUSCLE FUNCTION

LARRY C. LANDS McGill Univ., Montreal, Quebec, Canada, LAURA HORNBY McGill Univ., Montreal, Quebec, Canada, GILLES DESROCHERS McGill Univ., Montreal, Quebec, Canada, TED ILER McGill Univ., Montreal, Quebec, Canada, and GEORGE J. F. HEIGENHAUSER McGill Univ., Montreal, Quebec, Canada

Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2506-2510

The measurement of net pedaling torque during isokinetic cycling allows for the evaluation of leg muscle strength and work capacity over fixed time intervals. However, the expense and difficulty of constructing and isokinetic cycle have limited the widespread application of this useful research tool. We have modified a simple commercially available isokinetic cycle that uses hydraulics to maintain pedaling velocity. A strain gauge on the flywheel axle strut measures the torsion on the strut caused by pedaling. To evaluate this device, seven healthy subjects (3 males and 4 females) were each tested twice at 60, 90, and 120 rpm for peak power during a 10-s sprint and at 100 rpm for total work performed during a 30-s sprint. These results were compared with predicted values for age, height, and sex developed on a more complicated isokinetic cycle. Subjects also performed a progressive cycle ergometry test. For the group, peak power was 97.30 +/- 12.64% of predicted and work output was 107.70 +/- 15.75% of predicted, whereas maximal progressive exercise capacity was 126.40 +/- 25.84%. The relatively lower work values generated on this cycle (compared with the maximal progressive exercise capacity) can be attributed to the location of the strain gauge, resulting in measurement of effective work output on the flywheel. Peak power related significantly to lean body mass, whereas 30-s work output related strongly to both lean body mass and maximal exercise capacity. We conclude that this simple isokinetic cycle can

be used to make the same physiological measurements as the more complex device but that normative values should be established for this cycle. Author (Herner)

A95-73059
AGE-RELATED DIFFERENCES IN DIAPHRAGM MUSCLE INJURY AFTER LENGTHENING ACTIVATIONS
JON F. WATCHKO Univ. of Pittsburgh, Pittsburgh, PA, US, BRUCE D. JOHNSON Univ. of Pittsburgh, Pittsburgh, PA, US, LUC E. GOSSELIN Univ. of Pittsburgh, Pittsburgh, PA, US, Y. S. PRAKASH Univ. of Pittsburgh, Pittsburgh, PA, US, and GARY C. SIECK Univ. of Pittsburgh, Pittsburgh, PA, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2125-2133 Research sponsored by National Heart, Lung, and Blood Inst.
(HTN-95-50869)

The susceptibility of postnatal day 15 and adult rat diaphragms (DIAs) to acute injury after repetitive isovelocity lengthening activations was examined in vitro. Forces were measured during two phases of each stimulation protocol: (1) isometric phase: during the first 300 ms of each 500-ms train, DIA length was not changed; and (2) isovelocity lengthening phase: during the remaining 200 ms of each stimulus train, DIA was lengthened at a constant velocity from 90 to 110% of optimal length. At maximal activation (75 Hz and a lengthening velocity of 1.0 optimal length per second), the maximum force measured during the isometric phase and that measured during the isovelocity lengthening phase were both greater in adult DIAs than in day 15 DIAs but both declined to a greater extent in adults with repetitive activation. Ultrastructural analysis showed that after lengthening activations muscle fiber injury was very evident in adult but much less prevalent in day 15 DIAs. This difference in susceptibility between the adult and day 15 DIAs did not depend on differences in peak force or absolute velocity of lengthening. We conclude that lengthening activations results in DIA injury and that the adult is more susceptible than its younger counterpart.
Author (Herner)

A95-73060
METABOLIC CHARACTERISTICS OF PRIMARY INSPIRATORY AND EXPIRATORY MUSCLES IN THE DOG
SCOTT K. POWERS Univ. of Florida, Gainesville, FL, US, GASPAR A. FARKAS Univ. of Florida, Gainesville, FL, US, DAVID CRISWELL Univ. of Florida, Gainesville, FL, US, ROBERT A. HERB Univ. of Florida, Gainesville, FL, US, KIM ZAMBITO Univ. of Florida, Gainesville, FL, US, and STEPHEN DODD Univ. of Florida, Gainesville, FL, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2188-2193 Research sponsored by National Heart, Lung, and Blood Inst.; the Mayo Foundation; and the American Lung Association-Florida
(HTN-95-50870)

These experiments examined the metabolic properties of the canine respiratory muscles. Because the costal diaphragm (COD), crural diaphragm (CRD), parasternal intercostals (PI), triangularis sterni (TS), and transversus abdominis (TA) are active during quiet breathing in the dog, we hypothesized that these muscles would have different metabolic profiles (i.e., higher oxidative and antioxidant enzyme activities) compared with ventilatory muscles recruited only at increased ventilatory requirements (e.g., scalene (SC) and external oblique (EO)) and locomotor muscles (e.g., deltoid (DEL)). To test this hypothesis, muscles samples were removed from six healthy adult dogs and analyzed to determine the activities of citrate synthase (CS), phosphofructokinase (PFK), 3-hydroxyacyl-CoA dehydrogenase (HADH), and superoxide dismutase (SOD). The activities of these enzymes were interpreted as relative measures of metabolic capacities, and enzyme activity ratios were considered as representing relationships between different metabolic pathways. Analysis revealed that CS and HADH activities were significantly higher in the PI, COD, CRD, and TS compared with those in all other muscles. Muscles with the lowest CS, HADH, and SOD activities (i.e., SC, TA, EO, DEL) generally had the highest PFK activities. Furthermore, the PFK/CS ratio was significantly lower in the PI, COD, CRD, and TS compared with that in all other muscles studied. These data support the notion that the canine PI, COD, CRD, and TS are metabolically different from other key ventilatory muscles. Author (Herner)

A95-73061
EFFECT OF EXERCISE ON COLD TOLERANCE AND METABOLIC HEAT PRODUCTION IN ADULT AND AGED *C57BL/6J* MICE
ORIT SHECHTMAN National Inst. of Aging, Baltimore, MD, US and MARK I. TALAN National Inst. of Aging, Baltimore, MD, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2214-2218
(HTN-95-50871)

Two groups of adult (12-mo-old) and two groups of aged (24-mo-old) C57BL/67 male mice were subjected to a standardized cold stress test (3-h partial restraint at 6 C). One group from each age group was tested in the morning, and the other was tested in the afternoon. Half of the mice were subjected to running exercise on a treadmill during 1 h before the cold stress test. The other half were placed on a nonoperational treadmill for 1 h before the cold stress test. One hour of exercise resulted in improvement of cold tolerance during the subsequent cold exposure in both age groups but only during afternoon testing. Improvement in cold tolerance was not accompanied by an elevation of cold-induced metabolic heat production in adult mice. Metabolic heat production in aged mice showed only modest elevation. The discrepancy between improvement in cold tolerance and lack of elevation of metabolic heat production suggests that the primary mechanism for augmentation of cold tolerance after exercise in the afternoon is an improvement in cold-induced vasoconstriction of skin vessels, which is probably normally compromised in the afternoon.
Author (Herner)

A95-73062
RUNNING-INDUCED MUSCLE INJURY AND MYOCELLULAR ENZYME RELEASE IN RATS
JYRKI KOMULAINEN Univ. of Jyvaskyla, Jyvaskyla, Finland, JOHANNA KYTOLA Univ. of Jyvaskyla, Jyvaskyla, Finland, and VEIKKO VIHKO Univ. of Jyvaskyla, Jyvaskyla, Finland Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2299-2304 Research sponsored by the Finnish Ministry of Education
(HTN-95-50872)

The relationships and time course of exercise-induced muscle damage, estimated by beta-glucuronidase activity and microscopy, to muscle swelling, estimated by muscle water content and microscopy, and to the serum activity of creatine kinase (CK) and the concentration of carbonic anhydrase III were studied in rats 2, 12, 48, and 96 h after 90 min of intermittent running uphill (+13.5 deg) or downhill (-13.5 deg) at a speed of 17 m/min. The injury was more pronounced in soleus after uphill running and in the red parts of quadriceps femoris and in the white part of vastus lateralis after downhill running, whereas triceps brachii was not damaged. Increase in muscle water content preceded the increase of beta-glucuronidase activity. Both running protocols similarly increased serum CK 2 h postexercise. After downhill running a second peak in serum CK was observed 48 h later. The CK changes were not in concert with the changes in muscle water content or beta-glucuronidase activity, suggesting that these responses may not be mechanistically (or causally) related. Author (Herner)

A95-73063
INITIAL FALL IN SKELETAL MUSCLE FORCE DEVELOPMENT DURING ISCHEMIA IS RELATED TO OXYGEN AVAILABILITY
MICHAEL C. HOGAN Univ. of California at San Diego, La Jolla, CA, US, RUSSELL S. RICHARDSON Univ. of California at San Diego, La Jolla, CA, US, and S. SADI KURDAK Univ. of California at San Diego, La Jolla, CA, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2380-2384 Research sponsored by National Inst. of Health
(HTN-95-50873)

We examined the hypothesis that the initial decline (first 1-2 min) in force development that occurs in working muscle when blood

flow is halted is caused by O2 availability and not another factor related to blood flow. This was tested by reducing O2 delivery (muscle blood flow x arterial O2 content) to working muscle by either stopping blood flow (ischemia (I)) or maintaining blood flow with low arterial O2 content (hypoxemia (H)). If initial decline in force development were similar between these two methods of reducing O2 delivery, it would suggest O2 availability as the common pathway. Isolated dog gastrocnemius muscle was stimulated at approximately 60-70% of maximal O2 uptake (1 isometric tetanic contraction every 2 s) until steady-state conditions of muscle blood flow and developed force were attained (approximately 3 min). Two conditions were then sequentially imposed on the working muscle: I, induced by shutting off pump controlling arterial perfusion of the muscle and clamping venous outflow, and H, induced by perfusing the muscle with deoxygenated blood (collected before testing while animal breathed N2) at steady-state blood flow level. Rates of the fall in force production in 17 matched conditions of H and I approximately 40 s for each condition) were compared in 6 muscles tested. The blood perfusing the muscle during H had arterial PO2 = 8 +/- 1 (SE) Torr, arterial PCO2 = 37 +/- 1 Torr, and arterial pH = 7.39 +/- 0.03. The rate of decline in developed force was not significantly different between the 17 matched conditions of H and I. These findings suggest that the initial fall in developed force in working skeletal muscle that occurs with ischemia is related to O2 availability.

Author (Herner)

A95-73064

EFFECTS OF N-ACETYLCYSTEINE ON IN VITRO DIAPHRAGM FUNCTION ARE TEMPERATURE DEPENDENT

PHILIP T. DIAZ Ohio State Univ., Columbus, OH, US, ERICA BROWNSTEIN Ohio State Univ., Columbus, OH, US, and THOMAS L. CLANTON Ohio State Univ., Columbus, OH, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2434-2439
(HTN-95-50874)

Recent evidence has shown that systemic adminstration of N-acetylcysteine (NAC), a compound structually similar to the intracellular antioxidant glutahione, inhibits skeletal muscle fatigue. To further elucidate the actions of NAC, we studied its effects on in vitro rat diaphragm contractile function. Rat diaphragm strips were incubated in tissue baths containing physiological salt solution (n = 29) or physiological salt solution containing 4 mg/ml of NAC (n = 29). Strips were stimulated by either indirect or direct means. After determination of baseline contractile characteristics, strips were fatigued for 4 min at 20 Hz (1 train/s, 0.33 ms train duration). Force-frequency relationships were then studied over a 60-min recovery period. We found that (1) NAC had significant effects on the baseline force-frequency relationship; treated strips had increased peak tension but diminished twitch tension and accelerated twitch kinetics; (2) NAC had significant fatigue-sparing effects that were magnified at 37 C; and (3) NAC treatment did not improve postfatigue recovery. The effects of NAC were generally independent of the stimulation method. We conclude that NAC has direct temperature-dependent effects on diaphragm function. These effects are consistent with the properties of NAC as an antioxidant and suggest important but complex effects of oxidant stress on skeletal muscle.

Author (Herner)

A95-73065

METABOLIC AND WORK CAPACITY OF SKELETAL MUSCLE OF PFK-DEFICIENT DOGS STUDIED IN SITU

W. F. BRECHUE Univ. of Florida, Gainesville, FL, US, K. E. GROPP Univ. of Florida, Gainesville, FL, US, B. T. AMEREDES Univ. of Florida, Gainesville, FL, US, D. M. O'DROBINAK Univ. of Florida, Gainesville, FL, US, W. N. STAINSBY Univ. of Florida, Gainesville, FL, US, and J. W. HARVEY Univ. of Florida, Gainesville, FL, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2456-2467 Research sponsored by National Inst. of Health
(HTN-95-50875)

Mechanical and metabolic relationships of muscle lacking phosphofructokinase (PFKD) activity were compared with muscle having normal phsphofructokinase (NORM) activity by using the gastrocnemius-plantaris muscle group with isolated circulation in situ. Muscle contractile properties were similar in both groups. Initial power output (W) during repetitive tetanic (200 ms, 50 impulses/s) isotonic contractions was similar in both groups; however, W declined significantly more (30-80%) in PFKD than in NORM muscle over time, with a constant O2 uptake (VO2)/W. Despite similar O2 and substrate delivery, PFKD muscle had a lower VO2 (42-55%), less glucose uptake, similar free fatty acid uptake, and lactice acid uptake, rather than output, during contractions. Muscle venous H(+) concentration, strong ion difference, and PCO2 increased during contractions, the magnitude of change being smaller in PFKD muscle. Elevating arterial lactate concentration before contractions in PFKD muscle resulted in significant improvements in W and VO2 without altering the acid-base exchange at the muscle. Increasing O2 delivery by increasing arterial O2 concentration in PFKD dogs did not improve W or Vo2. We conclude that, despite no inherent mechanical or conctractile differences, PFKD muscle has a severely limited oxidative capacity and exaggerated fatigue and blood flow responses to contractions due to limited substrate metabolism resulting from the inability to utilize glycogen and/or glucose.

Author (Herner)

A95-73066

APNEA AFTER NORMOCAPNIC MECHANICAL VENTILATION DURING NREM SLEEP

ANN M. LEEVERS Univ. Wisconsin, Madison, WI, US, PEGGY M. SIMON Univ. Wisconsin, Madison, WI, US, and JEROME A. DEMPSEY Univ. Wisconsin, Madison, WI, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2079-2085 Research sponsored by the British Columbia Health Research Foundation, the National Heart, Lung, and Blood Inst., and the Medical Research Service of the Veterans Administration
(HTN-95-50876)

We determined whether normocapnic mechanical ventilation at high tidal volume (VT) and breathing frequency (f) during non-rapid-eye-movement (NREM) sleep would cause apnea. Seven normal sleeping subjects were placed on assist-control mechanical ventilation (i.e., subject initiates inspiration) and VT was gradually increased to 2.1 times eupneic VT. This high VT was maintained for 5 min, the ventilator mode was switched to controlled mechanical ventilation, and f was increased gradually from 9.5 +/- 1.0 (during assist-control mechanical ventilation) to 14.0 +/- 0.7 breaths/min. Normocapnia (end-tidal PCO2 = 44 +/- 1.2 Torr) was maintained throughout the trials. Inspiratory effort was completely inhibited during the period of sustained high VT and f, and apnea occurred immediately after cessation of the passive mechanical ventilation. The duration of the apnea preceding the first inspiratory effort was 20.3 +/- 2.3 s or 7.1 times the eupneic expiratory duration and 5 times the expiratory duration chosen by the subject during assist-control mechanical ventilation. We conclude that inhibition of inspiratory motor output occurs during and after normocapnic mechanical ventilation at high VT and f during NREM sleep. These neuromechanical inhibitory effects may serve to initiate and prolong apnea.

Author (Herner)

A95-73067* National Aeronautics and Space Administration, Washington, DC.

AORTIC BAROREFLEX CONTROL OF HEART RATE AFTER 15 DAYS OF SIMULATED MICROGRAVITY EXPOSURE

CRAIG G. CRANDALL Univ. of North Texas, Fort Worth, TX, US, KEITH A. ENGELKE Univ. of North Texas, Fort Worth, TX, US, VICTOR A. CONVERTINO Univ. of North Texas, Fort Worth, TX, US, and PETER B. RAVEN Univ. of North Texas, Fort Worth, TX, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994
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(Contract(s)/Grant(s): NGT-50751; NAS9-611; NAS10-10285)
(HTN-95-50877)

To determine the effects of simulated microgravity on aortic baroreflex control of heart rate, we exposed seven male subjects to 15 days of bed rest in the 6 deg head-down position. The sensitivity of the aortic-cardiac baroreflex was determined during a steady-

state phenylephrine-induced increase in mean arterial pressure combined with lower body negative pressure to counteract central venous pressure increases and neck pressure to offset the increased carotid sinus transmural pressure. The aortic-cardiac baroreflex gain was assessed by determining the ratio of the change in heart rate to the change in mean arterial pressure between baseline conditions and aortic baroreceptor-isolated conditions (i.e., phenylephrine + lower body negative pressure + neck pressure stage). Fifteen days of head-down tilt increased the gain of the aortic-cardiac baroreflex. Reductions in blood volume and/or maximal aerobic capacity may represent the underlying mechanism(s) responsible for increased aortic baroreflex responsiveness after exposure to a ground-based analogue of microgravity.

Author (Hemer)

A95-73068

VENTILATORY OUTPUT AND ACETYLCHOLINE: PERTURBATIONS IN RELEASE AND MUSCARINIC RECEPTOR ACTIVATION

M. D. BURTON Massachusetts General Hospital, Boston, MA, US, K. NOURI Massachusetts General Hospital, Boston, MA, US, S. BAICHOO Massachusetts General Hospital, Boston, MA, US, N. SAMUELS-TOYLOY Massachusetts General Hospital, Boston, MA, US, and H. KAZEMI Massachusetts General Hospital, Boston, MA, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2275-2284 Research sponsored by the William Randolph Hearst Foundation, the American Lung Association, and National Inst. of Health Division of Research Resources (HTN-95-50878)

Cholinergic transmission may be part of the normal neurochemical processes that support spontaneous ventilation. If this is true, perturbations in acetylcholine (ACh) turnover should alter ventilatory output in a predictable manner. With the use of the isolated perfused brain stem-spinal axis from the neonatal rat, the effects of modifiers of ACh release and blockers of muscarinic receptors on spontaneous C4 (phrenic) output were determined. Vesamicol and cetiedil, inhibitors of ACh release, caused depression and cessation of the C4 output in a dose-dependent manner when added to the perfusate. Muscarinic blockers, particularly M1 and M2 blockers, caused a similar depression. 4-Aminopyridine and tetraethylammonium chloride, facilitators of ACh release, caused stimulation of C4 (phrenic) output. The depressive effects of the blockers and inhibitors were reversible with facilitation of ACh release except in the case of cetiedil. These findings are consistent with the view that the synaptic turnover of endogenous ACh is an important part of the normal neurochemical process that supports and modulates ventilation.

Author (Hemer)

A95-73069

RESPIRATORY MUSCLE ACTIVITY DURING SLEEP-INDUCED PERIODIC BREATHING IN THE ELDERLY

DAVID W. HUDGEL Case Western Reserve Univ., Cleveland, OH, US and HERBERT B. HAMILTON Case Western Reserve Univ., Cleveland, OH, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2285-2290 Research sponsored by National Inst. on Aging
(HTN-95-50879)

The purpose of this study was to address the mechanism of the relationship between oscillations in tidal volume and upper airway resistance in elderly subjects with sleep-induced periodic breathing. We hypothesized that the spontaneous periodic breathing observed in non-rapid-eye-movement (NREM) sleep in elderly subjects would be closely related to fluctuations in upper airway resistance and not to changes in central motor drive to ventilatory pump muscles. Therefore, in eight healthy elderly subjects, we measured costal margin chest wall peak moving time average electrical inspiratory activity (CW EMG), ventilation variables, and upper airway resistance during sleep. Five of eight subjects had significant sine wave oscillations in upper airway resistance and tidal volume. For these five subjects, there was a reciprocal exponential relationship between peak upper airway inspiratory resistance and tidal volume or minute ventilation, such that as resistance increased, ventilation decreased. The relationship between CW EMG and tidal volume or minute ventilation was quite low. This study demonstrated that oscillations in ventilation during NREM sleep in elderly subjects were significantly related to fluctuations in upper airway resistance but were not related to changes in chest wall muscle electrical activity. Therefore, changes in upper airway caliber likely contribute to oscillations in ventilation seen during sleep-induced periodic breathing in the elderly.

Author (Hemer)

A95-73070

SYMPATHETIC AND BLOOD PRESSURE RESPONSES TO VOLUNTARY APNEA ARE AUGMENTED BY HYPOXEMIA

J. CULLEN HARDY Pennsylvania State Univ., Hershey, PA, US, KRISTEN GRAY Pennsylvania State Univ., Hershey, PA, US, SANDRA WHISLER Pennsylvania State Univ., Hershey, PA, US, and URS LEUENBERGER Pennsylvania State Univ., Hershey, PA, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2360-2365 Research sponsored by National Heart, Lung, and Blood Inst.
(HTN-95-50880)

Oscillations of arterial pressure during sleep are the hemodynamic hallmark of the sleep apnea syndrome. The mechanism of these transient pressure elevations is incompletely understood. To investigate the role of the arterial chemoreflex in the neurocirculatory responses to apnea, we measured mean arterial pressure (MAP; Finapres) and muscle sympathetic nerve activity (MSNA; peroneal microneurography) during voluntary end-expiratory apnea during exposure to room air, 10.5% O2 in N2 (hypoxemia), and 100% O2 (hyperoxia) in 11 healthy men. While the men breathed spontaneously, MSNA (in bursts/min) rose during hypoxemia and decreased during hyperoxia and MAP remained unchanged. During room air exposure, apnea led to a rise of 94 +/- 54% in MSNA total amplitude and a rise of 6.5 +/- 2.1 mmHg in MAP. MSNA and MAP increased by 616 +/- 158% and 10.8 +/- 2.4 mmHg, respectively, during hypoxemic apnea of equal duration (time-matched responses) and by 98 +/- 41% and 4.9 +/- 2.0 mmHg, respectively, during hyperoxic apnea. Thus, in awake healthy humans, activation of the arterial chemoreflex by hypoxemia appears to contribute importantly to the sympathetic and blood pressure responses to apnea.

Author (Hemer)

A95-73071

ROLE OF CA(2+) IN PROTECTING THE HEART FROM HYPERKALEMIA AND ACIDOSIS IN THE RABIT: IMPLICATIONS FOR EXERCISE

STEWART P. LEITCH Univ. Lab. of Physiology, Oxford, UK and DAVID J. PATERSON Univ. Lab. of Physiology, Oxford, UK Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2391-2399 Research sponsored by the Wellcome Trust, the British Heart Foundation (BHF), and the Royal Society
(HTN-95-50881)

Catecholamines can offset the negative effect of acidosis and raised extracellular K(+) concentration in the isolated rabbit heart when these factors are changed with similar kinetics and concentrations as those observed in exercise. This effect appears to be mediated by changes in Ca(2+) handling in the heart. To test the role of Ca(2+) in vivo, we studied the interactive effects of infusions of KCl, lactic acid, norepinephrine (NE), and CaCl2 on cardiovascular performance in the anesthetized rabbit. After propranolol, CaCl2 was given during acidosis and hyperkalemia. Acidosis markedly reduced cardiac performance, and its effects were exacerbated by hyperkalemia. NE reserved the cardiac response to combined acidosis and hyperkalemia. After propranolol, arterial pH and arterial K(+) concentration changed more rapidly with acidosis and hyperkalemia, combined with a faster fall in cardiac performance, but CaCl2 offset these negative hemodynamic effects. The rises in plasma Ca(2+), NE, and sympathetic activity during exercise may

therefore interact to ameliorate the harmful effects of acidosis and hyperkalemia. Author (Herner)

A95-73072
CARDIOVASCULAR AND RENAL NERVE RESPONSES TO STATIC MUSCLE CONTRACTION OF DECEREBRATE RABBITS
L. BRITT WILSON Univ. of Texas, Dallas, TX, US, CHRISTOPHER K. DYKE Univ. of Texas, Dallas, TX, US, JAMES A. PAWELCZYK Univ. of Texas, Dallas, TX, US, P. TIM WALL Univ. of Texas, Dallas, TX, US, and JERE H. MITCHELL Univ. of Texas, Dallas, TX, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2449-2455 Research sponsored by National Inst. of Neurological Disorders and Stroke and the Lawson and Rogers Lacy Fund in Cardiovascular Diseases
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The purpose of this study was to determine whether the biphasic arterial blood pressure responses elicited by static muscle contraction of decerebrate rabbits are mediated, at least in part, by an initial decrease and a subsequent increase in sympathetic outflow. Renal sympathetic nerve activity (RSNA) was used as an index of sympathetic outflow. Static contraction of the triceps surae muscle (n = 14) initially decreased mean arterial blood pressure (MAP) -20 +/- 3 mmHg and heart rate (HR) -15 +/- 5 beats/min (nadir values). After this initial decrease, MAP increase 12 +/- 2 mmHg (peak increase) above baseline and there was a tendency for HR to be elevated (6 +/- 3 beats/min). The changes in RSNA during muscle contraction (n = 6) mirrored the nadir and peak responses of MAP (-50 +/- 9 and 32 +/- 11%). Muscle stretch (n = 11) also evoked similar nadir and peak responses of MAP (-20 +/- 5 and 9 +/- 1 mmHg), HR(-17 +/- 7 and 3 +/- 3 beats/min), and RSNA (-43 +/- 9 and 46 +/- 15%). These data suggest that the initial depressor and subsequent pressor responses elicited by skeleton muscle contraction and stretch are mediated, at least in part, by biphasic changes in sympathetic outflow. Author (Herner)

A95-73073
GEOMETRY OF RESPIRATORY PHASE SWITCHING
MICHEL SAMMON Dartmouth Medical School, Lebanon, NH, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2468-2480 Research sponsored by National Heart, Lung, and Blood Inst.
(HTN-95-50883) Copyright

A second-order ordinary differential equation is outlined for the temporal dynamics of the respiratory central pattern generator (RCPG). Recurrent interactions between central excitation and inhibition confine the breathing cycle to the interior of a heteroclinic orbit between switching points (saddle equilibria) located at end expiration (E-I) and end inspiration (I-E). Dynamics depend on four eigenvalues that control inspiratory drive (lambda), excitability of inspiratory off switch (omega(sub 1); stage 1 expiration), rate of central excitation disinhibition (omega(sub 2); stage 2 expiration), and damping of the oscillator (epsilon). Ratios omega(sub 2)/lambda and omega(sub 1)/lambda determine local E-I and I-E phase switching, whereas inspiratory-to-expiratory balance varies as omega(sub 2)/(lambda omega(sub 1)). Stable apnea is seen when (lambda omega(sub 2))/epsilon is near zero; inspiratory apneusis is seen when (lambda omega(sub 1))/epsilon is low. The equations provide formalisms for discussing phase switching, apneas, apneuses, phase resetting and singularities, rapid shallow breathing, postinhibitory rebound excitation, redundancy, gating within the RCPG, and behavioral control of breathing. The model is offered as an explicit alternative to the harmonic oscillator models that have been used in the past to desrcribe RCPG function.
Author (Herner)

A95-73074
SYMMETRY, BIFURCATIONS, AND CHAOS IN A DISTRIBUTED RESPIRATORY CONTROL SYSTEM
MICHEL SAMMON Dartmouth Medical School, Lebanon, NH, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2481-2495 Research sponsored by National Heart, Lung, and Blood Inst.
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A multivariate model is outlined for a distributed respiratory central pattern generator (RCPG) and its afferent control. Oscillatory behavior of the system depends on structure and symmetry of a matrix of phase-switching functions (F(sub omega, phi)) that control distribution of central excitation (CE) and inhibition (CI) within the circuit. The matrix diagnonal (F(sub omega)) controls activation of CI variables as excitatory inputs are altered (e.g., central and afferent contributions to inspiratory off switch); off-diagonal terms (F(sub phi)) distribute excitation within the CI system and produce complex eigenvalues at the switching points between inspiration and expiration. For null F(sub phi), phase switchings of saddle equilibria located at end expiration and end inspiration are overdamped all-or-nothing events; graded control of CI is seen for phi greater than 0. When coupling is significant (phi much greater than 0), CI dynamics before underdamped, admitting a domain of inputs where chaotic behavior is predictably observed. For the homogeneous RCPG (symmetric F(sub omega, phi)), CE oscillations are one-dimensional limit cycles or weakly chaotic. When perturbations from symmetry are significant, the distributed RCPG becomes partitioned where strongly chaotic oscillations and central apnea are seen more frequently. The equations provide means for mapping Silnikov bifurcations that alter the geometry and dimension of the breathing pattern and formalisms for discussing RCPG processing of afferent information. Author (Herner)

A95-73075
OXYGEN SENSORS IN VASCULAR SMOOTH MUSCLE
Y. KATAYAMA Univ. of Pennsylvania, Philadelphia, PA, US, R. F. COBURN Univ. of Pennsylvania, Philadelphia, PA, US, W. S. FILLERS Univ. of Pennsylvania, Philadelphia, PA, US, and C. B. BARON Univ. of Pennsylvania, Philadelphia, PA, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2086-2092 Research sponsored by National Heart, Lung, and Blood Inst.
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Inhibition or activation of cellular function due to acute decreases in PO2 can be considered in terms of two different processes: (1) a sensor that monitor PO2 decreases and (2) transduction systems directed from the O2 sensor to reactions that control cellular function. We used the norepinephrine-contracted aortic smooth muscle model to study the nature of the O2 sensor and transduction system during decreased PO2-evoked relaxations. The phosphorylation potential, a measurement of kinetic energy required for ATP hydrolysis, was decreased to 30% of control at the onset of relaxation and progressively fell as muscle relaxed. The free inorganic phosphate intracellular concentration (P(sub i)) was experimentally increased approximately 0.6 mM during transients that followed a rapid decreased in PO2. Relaxations to 80% of maximal force were more rapid under conditions of an augmented (P(sub i)) than in control rings, and they occurred at a higher phosphocreatine concentration and phosphocreatine-to-free creatine ratio but at the same phosphorylation potential. Results support the operation of a cytochrome aa3 O2 sensor in the mechanism of decreased PO2-evoked relaxations and implicate and increase in (P(sub i)) and a decrease in kinetic energy in the transduction mechanism directed at rate-limiting reactions that control force.
Author (Herner)

A95-73076
FAILURE OF HEMOCONCENTRATION DURING STANDING TO REVEAL PLASMA VOLUME DECLINE INDUCED IN THE ERECT POSTURE
JAN LUNDVALL Vaexjoe Hospital, Vaexjoe, Sweden and PER BJERKHOEL Vaexjoe Hospital, Vaexjoe, Sweden Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2155-2162
(HTN-95-50886) Copyright

The hypothesis was tested that the hemoconcentration observed during standing provides erroneous information about the

induced plasma volume (PV) decline. Male volunteers (n = 10) stood quietly for 15 min after supine rest. On standing arterial hemoglobin (Hb) rose slowly to reach and increase of 5.9 +/- 0.3% (SE) after 15 min. Early after resuming the supine position, Hb increased further to 9.2 +/- 0.5% above control level and then declined gradually. Venous atencubital blood from the left arm supported horizontally at heart level in both the supine and standing positions (no hydrostatic load) showed very similar changes. However, Hb in venous blood collected during standing from the right arm held in the natural dependent position rose much more markedly than that in arterial blood and in venous blood from the horizontal arm. Taken together, these observations indicated that (1) analyses of arterial blood sampled from the standing subject grossly underestimated the prevailing 'overall' hemoconcentration and PV decline, a phenomenon ascribed to incomplete mixing of blood between dependent and nondependent regions; (2) arterial blood sampled from the recumbent subject early (60 s) after completion of standing reflected the 'true' overall intravascular hemoconcentration, with a calculated PV decline of no less than 511 +/- 27 ml, because the supine position facilitated proper mixing of blood between circulatory compartments; (3) data from common venous sampling from the dependent arm during standing primarily reflected a regional hemoconcentration (fluid loss) in the arm rather than PV decline; and (4) short-term quiet standing caused a more prominent and hemodynamically important decrease in PV than usually believed. Author (Hemer)

A95-73077* National Aeronautics and Space Administration, Washington, DC.
MICROVASCULAR RESPONSES TO BODY TILT IN CUTANEOUS MAXIMUS MUSCLE OF CONSCIOUS RATS
ROHIT K. PURI Pennsylvania State Univ., University Park, PA, US and STEVEN S. SEGAL Pennsylvania State Univ., University Park, PA, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2426-2433 Research sponsored by National Heart, Lung, and Blood Inst.
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(HTN-95-50887)

We investigated microvascular responses to head-up tilt (HUT) and head-down tilt (HDT) in striated muscle of conscious male rats. To observe the microcirculation in the cutaneous maximus muscle, a transparent polycarbonate chamber was implanted aseptically into a skin fold created between the shoulders. Rats were trained to sit quietly during HUT and HDT while positioned on a horizontal microscope that rotated in the sagittal plane. At 4-5 days after surgery, arteriole and venule diameters were recorded using videomicroscopy while the rat experienced 10 min each (in random order) of HUT or HDT at 20 deg or 40 deg separated by 2-h rest periods. HUT had no affect on microvessel diameter; 20 deg HDT had little affect. In response to 40 deg HDT, 'large' arterioles constricted by 18 +/- 2% and 'small' arterioles dilated by 21 +/- 3%; this difference suggested variation in mechanisms controlling arteriolar responses. Venules exhibited a larger fluctuation in diameter during 40 deg HDT compared with other body positions, suggesting that venomotor activity may be induced with sufficient fluid shift or change in central venous pressure. These observations illustrate a viable model for studying microvascular responses to gravitational stress in conscious rats. Author (Hemer)

A95-73078
INFERENCES ON PASSIVE DIAPHRAGM MECHANICS FROM GROSS ANATOMY
ALADIN M. BORIEK Baylor College of Medicine, Houston, TX, US and JOSEPH R. RODARTE Baylor College of Medicine, Houston, TX, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2065-2070 Research sponsored by National Heart, Lung, and Blood Inst. and the Whitaker Foundation
(HTN-95-50888)

The diaphragm is a relatively thin curved structure that is categorized in mechanics as a membrane. Tension in the membrane is given by the product of muscle thickness and stress parallel to the fiber bundles. If all muscle fibers were cylindrical and extended from origin to insertion, the ratio of thickness near the chest wall (CW) to thickness near the central tendon (CT) would vary inversely with the ratio of CW to CT perimeters. In freshly excised diaphragms of 36 mongrel dogs, the ratios of the perimeters (CT/CW) in the right and left costal diaphragm were 0.63 +/- 0.04 and 0.62 +/- 0.04, respectively. The means of the ratio of thickness near CW to that near CT in the right and left costal regions were 0.96 +/- 0.07 and 0.95 +/- 0.05, respectively, consistent with a nearly constant relationship between costal diaphragm membrane tension and muscle stress in the direction of the fibers. In the crural diaphragm, the average ratio of the perimeters of the insertions on CT to CW was 1.16 +/- 0.10. The average ratio of thickness of crural CW to CT was 1.25 +/- 0.11. The discrepancy between the perimeter ratio and thickness ratio in the costal diaphragm is incompatible with the muscle consisting of uniform fibers extending from CW to CT. Our data suggest that muscle fibers are either in series with a smaller number along the smaller perimeter or that they terminate by tapering within the muscle bundle. Both arrangements are consistent with previous anatomic studies (Gordon et al., 1989). Having a nonuniform number of fibers mechanically in series is compatible with uniform stress in the fibers if the membrane is sufficiently curved as in a domed structure. Author (Hemer)

A95-73079
ACUTE PULMONARY RESPONSE TO INTRAVENOUS HISTAMINE USING FORCED OSCILLATIONS THROUGH ALVEOLAR CAPSULES IN DOGS
MICHIAKI MISHIMA McGill Univ., Montreal, Quebec, Canada, ZSOLT BALASSY McGill Univ., Montreal, Quebec, Canada, and JASON H. T. BATES McGill Univ., Montreal, Quebec, Canada Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2140-2148 Research sponsored by the Medical Research Council of Canada, the J. T. Costello Memorial Research Fund, and the Canadian Network of Centers of Excellence in Respiratory Health
(HTN-95-50889)

We measured the time course of alveolar input impedance using two alveolar capsule oscillators after intravenous bolus adminstration of 20 mg of histamine in open-chest dogs. Impedances (24-200 Hz) were obtained every 2 s after an injection for 100 s. Each impedance was fit with a model consisting of a pathway (with resistance and inertance) leading from the alveolar capsule into a subpleural region (with elastance EA) that, in turn, was connected to the lung compartment (consisting of the remainder of the lung and positive end-expiratory pressure system) via another pathway (with resistance RA). In all cases (6 dogs, 2 capsules each), the resistance and inertance leading from the alveolar capsules were negligible. The correlation of the relative increases in RA obtained from the two capsule oscillators in each dog was not significant. The correlation for EA also was not significant. The times at which RA achieved values of 20% greater than baseline were not significantly correlated between the two capsules, as was the case for EA. However, the baseline values of EA and RA from a given capsule were significantly correlated, as were their fractional increaseswith histamine. These results show that both the magnitude and timing of changes in local lung resistance and elastance are spatially extremely heterogeneous. Author (Hemer)

A95-73080
RESPIRATORY MUSCLE PRESSURE ANALYSIS IN PRESSURE-SUPPORT VENTILATION
YOSHITSUGU YAMADA Univ. of Tokyo, Tokyo, Japan, MASAKI SHIGETA Univ. of Tokyo, Tokyo, Japan, KUNIO SUWA Univ. of Tokyo, Tokyo, Japan, and KAZUO HANAOKA Univ. of Tokyo, Tokyo, Japan Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2237-2243 Research sponsored by the Japan Ministry of Education for Scientific Research
(HTN-95-50890)

The extent to which respiratory muscles are exerted during partially supported ventilation is difficult to differentiate, because these muscles and the ventilator work simultaneously to produce

ventilation. We have developed a new method for determining the pressure developed by the respiratory muscles in partially supported ventilation. In seven patients on pressure-support ventilation (PSV), pressure, flow and lung volume change were measured at the airway opening. Various PSV levels (0-15 cmH2O) were applied to each patient in random order. By utilizing a model of respiratory mechanics, we calculated the pressure developed by the respiratory muscles and the inspiratory work performed by the muscles from the measured parameters by use of the resistance and elastance of the respiratory system obtained during controlled ventilation. Increasing PSV from 0 to 15 cmH2O modulated the resultant breathing pattern, i.e., increasing tidal volume and decreasing respiratory rate. The respiratory muscle pressure, although less negative, had a shape that corresponded to the shape of airway occlusion pressure at each PSV level, and both pressures decreased concomitantly with increasing PSV. The respiratory muscle work progressively decreased with increasing PSV. This analysis enabled clear and continuous quantifications of the respiratory muscle force generation and inspiratory work during partially supported ventilation.
Author (Herner)

A95-73081
GLUCOCORTICOIDS INHIBIT SULFUR MUSTARD-INDUCED AIRWAY MUSCLE HYPERRESPONSIVENESS TO SUBSTANCE P

J. H. CALVET Faculte de Medecine de Creteil, Creteil, France, M. P. D'ORTHO Faculte de Medecine de Creteil, Creteil, France, P. H. JARREAU Faculte de Medecine de Creteil, Creteil, France, M. LEVAME Faculte de Medecine de Creteil, Creteil, France, A. HARF Faculte de Medecine de Creteil, Creteil, France, and I. MACQUIN-MAVIER Faculte de Medecine de Creteil, Creteil, France Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2325-2332
(Contract(s)/Grant(s): DRET-92/1219A)
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To explore the mechanisms of airway hyperreactivity to aerosolized substance P observed in guinea pigs 14 days after intratracheal injection of sulfur mustard (SM), we studied the effects of epithelium removal and inhibition of neutral endopeptidase (NEP) activity on airway muscle responsiveness. Tracheal rings from SM-intoxicated guinea pigs expressed a greater contractile response to substance P than rings from nonintoxicated guinea pigs. After epithelium removal or incubation with the NEP inhibitor phosphoramidon, the contractile responses of tracheal rings to substance P did not differ in guinea pigs injected with SM or ethanol (SM solvent). Treatment of the guinea pigs with betamethasone for 7 days before measurement abolished the airway muscle hyperresponsiveness observed in untreated SM-intoxicated guinea pigs and partially restored tracheal epithelium NEP activity. In addition, the tracheal epithelium height and cell density of SM-intoxicated guinea pigs treated with betamethasone were significantly greater than in those without betamethasone. These results demonstrate that SM intoxication induces airway muscle hyperresponsiveness to substance P by reducing tracheal epithelial NEP activity and that glucocorticoids might inhibit this hyperresponsiveness by increasing this activity. Author (Herner)

A95-73082
AIRWAY SURFACE LIQUID THICKNESS AS A FUNCTION OF LUNG VOLUME IN SMALL AIRWAYS OF THE GUINEA PIG

D. YAGER Harvard School of Public Health, Boston, MA, US, T. CLOUTIER Harvard School of Public Health, Boston, MA, US, H. FELDMAN Harvard School of Public Health, Boston, MA, US, J. BASTACKY Harvard School of Public Health, Boston, MA, US, J. M. DRAZEN Harvard School of Public Health, Boston, MA, US, and R. D. KAMM Harvard School of Public Health, Boston, MA, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2333-2340 Research sponsored by National Heart, Lung, and Blood Inst. and the Tobacco-Related Disease Research Program of the State of California
(Contract(s)/Grant(s): DE-AC03-76SF-00098)
(HTN-95-50892) Copyright

The average thickness and distribution of airway surface liquid (ASL) on the luminal surface of peripheral airways were measured in normal guinea pig lungs frozen at functional residual capacity (FRC) and total lung capacity (TLC). Tissue blocks were cut from frozen lungs and imaged by low-temperature scanning electron microscopy (LTSEM). Measurements were found to be independent of freezing rate by comparison of measurements at rapid and slow freezing rates. At both lung volumes, the ASL was not uniformly distributed in either the circumferential or longitudinal direction. Discernible liquid on the surfaces of airways frozen at FRC followed the contours of epithelial cells and collected in pockets formed by neighboring cells, a geometry consistent with a low value of surface tension at the air-liquid interface. At TLC airway liquid collected to cover epithelial cells and to form a liquid meniscus, a geometry consistent with a higher value of surface tension. The average ASL thickness (h) was approximately proportional to the square root of airway internal perimeter, regardless of lung volume. For a given airway internal perimeter, h was 1.99 times thicker at TLC than at FRC; the difference was statistically significant. These measurements suggest that the ASL layer is highly dynamic and that movement of liquid across the airway wall and along the aiway tree are both significant factors in establishing ASL thickness under normal conditions. Transepithelial pressure gradents, ion transport, and intraluminal surface tension gradients are potential mechanisms driving ASL flow, and accumulation or depletion of the ASL via these mechanisms can occur on time scales of less than 1 min.
Author (Herner)

A95-73083
RESTRICTED POSTEXERCISE PULMONARY DIFFUSION CAPACITY DOES NOT IMPAIR MAXIMAL TRANSPORT FOR O2

BIRGITTE HANEL Univ. of Copenhagen, Copenhagen, Denmark, PHILIP S. CLIFFORD Univ. of Copenhagen, Copenhagen, Denmark, and NIELS H. SECHER Univ. of Copenhagen, Copenhagen, Denmark Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2408-2412 Research sponsored by the American College of Sports Medicine
(HTN-95-50893) Copyright

We evaluated whether the posterxercise reduction of pulmonary diffusion capacity for carbon monoxide (DL(sub CO) is influenced by a second bout of rowing and whether it affects arterial O2 tension during maximal exercise. After exercise, DL(sub CO) was reduced and both the membrane diffusion capacity and the pulmonary capillary blood volume were affected. A second bout of exercise did not influence DL(sub CO) or membrane diffusion capacity (n = 7), but during both bouts arterial O2 tension was reduced and arterial O2 saturation decreased. Furosemide (iv) did not affect DL(sub CO) (n = 7), suggesting that it was influenced by the central blood volume rather than by pulmonary edema. Author (Herner)

A95-73084
STREPTOCOCCUS PNEUMONIAE-INDUCED PULMONARY HYPERTENSION AND SYSTEMIC HYPOTENSION IN ANESTHETIZED SHEEP

NIRMAL B. CHARAN Veterans Affairs Medical Center, Boise, ID, US, RAMAGOPAL V. MUDUMBI Veterans Affairs Medical Center, Boise, ID, US, PATRICIA HAWK Veterans Affairs Medical Center, Boise, ID, US, ROBERT E. VESTAL Veterans Affairs Medical Center, Boise, ID, US, and PAULA CARVALHO Veterans Affairs Medical Center, Boise, ID, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2071-2078 Research sponsored by National Heart, Lung, and Blood Inst. and the Dept. of Veterans Affairs
(HTN-95-50894) Copyright

Because some patients with Streptococcus pneumoniae bacteremia may present with shock, we reasoned that this organism

may produce substances that cause shock. To test this hypothesis, type III pneumococcus supernatant, suspended in 10 ml of sterile water, was infused over 1 min in 8 adult anesthetized sheep. Normal saline was used as a control and had no effect on any of the hemodynamic parameters. Infusion of supernatant resulted in a precipitous fall in cardiac output from a control value of 4.25 +/- 0.54 to 2.80 +/- 0.43 (SE) l/min, a fall in mean systemic arterial pressure from 70 +/- 4 to 49 +/- 8 mmHg, and an increase in the mean pulmonary arterial pressure from 13 +/- 2 to 23 +/- 4 mmHg within 1 min after the infusion was completed. The peak hemodynamic effects were observed at approximately 3 min and returned to normal within 10 min after the infusion was completed. The thromboxane B2 level increased from a control value of 10 +/- 5 to 156 +/- 43 pg/ml at 3 min after the infusion was completed and decreased to 63 +/- 34 pg/ml at 20 min. A second identical dose of pneumococcal supernatant, repeated within 2 h of the first dose, had no effect on hemodynamic variables. Pretreatment with indomethacin, 5 mg/kg body wt, completely blocked the hemodynamic effects of pneumococcal supernatant (n = 3 sheep). Thus, we conclude that S. pneumoniae supernatant contains substances that cause septic shock syndrome through the synthesis of arachidonic acid metabolites and that a sublethal dose of the supernatant causes rapid tachyphylaxis.
Author (Herner)

A95-73085
CONTINUOUS MEASUREMENTS OF CHANGES IN PULMONARY CAPILLARY SURFACE AREA WITH TL-201 INFUSIONS
RICHARD M. EFFROS Medical College of Wisconsin, Milwaukee, WI, US, ALLEN HACKER Medical College of Wisconsin, Milwaukee, WI, US, ELIZABETH JACOBS Medical College of Wisconsin, Milwaukee, WI, US, S. AUDI Medical College of Wisconsin, Milwaukee, WI, US, and CONNIE MURPHY Medical College of Wisconsin, Milwaukee, WI, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2093-2103 Research sponsored by National Heart, Lung, and Blood Inst.
(HTN-95-50895)

The impact of physiological and pathological processes on metabolism and transport of a variety of substances traversing the pulmonary vasculature depends in part on the capillary surface area available for exchange, and a reliable method for detecting changes in this parameter is needed. In this study, a continuous-infusion approach was used to investigate the response of the pulmonary capillary surface area to increases in flow and left artrial pressure. Isolated rat lungs were perfused with an acellular perfusion solution containing I-125-labeled albumin (an intravascular indicator) and Tl-201, a K(+) analogue which is concentrated within lung cells. The extraction of Tl-201 from the perfusate was 61% greater at low flow (8.5 ml/min) than that at high flow (26 ml/min), and rapid changes in extraction were observed when flow was altered. In contrast, the permeability-surface area product was 76% greater when lungs were perfused at high flow than at low flow, suggesting comparable increases in pulmonary capillary surface area in these zone 2 lungs (airway pressure = 5 cmH2O, left atrial pressure less than 0 cmH2O). In a second group of experiments, increases in left atrial pressure to 14 cmH2O (zone 3 lungs) at a constant flow of 8.5 ml/min increased the permeability-surface area product by only 18% despite increases in average intravascular pressure that were at least as high as those associated with high perfussion rates. Tl-201 infusions provide a useful method for detecting and quantifying changes in pulmonary capillary surface area. Author (Herner)

A95-73086
PULMONARY INTERSTITIAL PRESSURE IN ANESTHETIZED PARALYZED NEWBORN RABBITS
GIUSEPPE MISEROCCHI Univ. degli Studi, Milan, Italy, BESA HAXHIU POSKURICA Univ. degli Studi, Milan, Italy, and MASSIMO DEL FABBRO Univ. degli Studi, Milan, Italy Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2260-2268 Research sponsored by the Italian Ministry of the University and the Scientific and Technological Research
(HTN-95-50896)

In anesthetized paralyzed term newborn rabbits at various postgestational ages (from birth up to 16 days), we measured by micropuncture technique the hydraulic pressure of the pulmonary interstitium (Pip), the extrapleural parietal interstitium, and the pleural liquid. Birth data refer to cesarian-delivered nonbreathing rabbits. Pip increased from 0.5 +/- 2 to 6 +/- 0.7 cmH2O from birth up to 2 h and then decreased, becoming subatmosphe6ric at 5 h and attaining -6 +/- 1.6 cmH2O at 16 days. Over the same period of time, pressure in the extrapleural parietal interstitium and the pleural liquid remained fairly constant at an average value of approximately -1.5 and -2 cmH2O, respectively. The wet-to-dry weight ratio of the lungs decreased from 7.8 +/- 0.4 to 4.9 +/- 0.1 at 16 days. Plasma protein concentration was 4.2 +/- 0.4 g/dl at birth, decreased to 3.2 +/- 0.5 g/dl at 1 h from delivery, and increased back to 4 +/- 0.6 g/dl at 16 days. Pleural liquid protein concentration was 3 +/- 0.1 g/dl at birth and decreased to 1.2 +/- 0.2 g/dl at 16 days. In the first hours of postnatal life, the marked increase in Pip appears to be a key factor in favoring fluid clearance from pulmonary interstitium into the pulmonary capillaries and the pleural space. This factor vanished after approximately 6 h because of the marked decreased in Pip.
Author (Herner)

A95-73087
OSMOLALITY ALTERS TRACHEAL BLOOD FLOW AND TRACER UPTAKE IN ANESTHETIZED SHEEP
U. M. WELLS St. George's Hospital Medical School, London, UK, Z. HANAFI St. George's Hospital Medical School, London, UK, and J. G. WIDDICOMBE St. George's Hospital Medical School, London, UK Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2400-2407 Research sponsored by the National Asthma Campaign
(HTN-95-50897)

Changes in the osmolality of airway surface liquid cause bronchoconstriction, mucus secretion, and ion transport, but little is known about the effects on the permeability of the trachea to drugs applied to the tracheal lumen. Using the anesthetized sheep, we have investigated the effects of hyperosmolar and hyposmolar Krebs-Henseleit (KH) solution in the tracheal lumen on the uptake of technetium-99m-labeled diethylenetriamine pentaacetic acid (Tc-99m-DTPA), a low-molecular-mass hydrophilic tracer that is thought to cross the epithelium via paracellular pathways, and on blood flow. All changes in osmolality were made by altering the NaCl content. We perfused a tracheal artery and collected tracheal venous blood. Hyperosmola KH increased water movement into the lumen (+2.0 ml) and solute flux out of the lumen. It increased arterial (+24.5%) and venous (+20.6%) flows and decreased Tc-99m-DTPA concentration (-26.3%) and output (-12.0%) in venous blood. Hyposmolar KH caused water movement out of the lumen (-0.9 ml) and solute flux into the lumen. It had no effect on arterial (+0.6%) and venous (+5.5%) flows and greatly increased the concentration (+345%) and output (+375%) of Tc-99m-DTPA in venous blood. The baseline permeability coefficient for Tc-99m-DTPA in venous blood. The baseline permeability coefficient for Tc-99m-DTPA was not affected by hyperosmolar KH but was increased by hyposmolar KH. These results confirm that hyperosmolar liquid in the lumen increases blood flow and indicate that tracer uptake is affected by the bulk flow of water across the airway wall. Author (Herner)

A95-73088
USE OF SCALING THEORY TO RELATE MEASUREMENTS OF LUNG ENDOTHELIAL BARRIER PERMEABILITY
T. R. HARRIS Vanderbilt Univ., Nashville, TN, US, C. M. WATERS Vanderbilt Univ., Nashville, TN, US, and F. R. HASELTON Vanderbilt Univ., Nashville, TN, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 5 November 1994 p. 2496-2505
(Contract(s)/Grant(s): NIH-RR-06558; NIH-HL-40554)
(HTN-95-50898)

This work examined the relationships between lung microvas-

cular permeability-surface area products (PS) for small solutes in animals of different size and for columns of endothelial-covered microcarrier beads. We assembled PS data (humans, sheep, lambs, and rabbits) for labeled sucrose, mannitol, urea, 1,2-propanediol, 1,3-propanediol, and 1,4-butanediol. In addition, PS for cell columns using sucrose, mannitol, and sodium fluorescein were evaluated. A new mathematical model for the analysis of cell columns that accounts for transit time variations was derived and compared with models neglecting this variation. Allometric relationships between PS and body weight or exchange surface (S) were examined. Permeability relative to diffusivity (P/D) correlated inversely with S for all animals. In addition, P/D for the cell columns fell near this regression line. The results suggest either that permeability for hydrophilic tracers is higher for smaller animals or that the indicator-dilution measurement is a fractal process dependent on scale. Furthermore, the P/D-S correlations may help relate cell column experiments to animal studies. Author (Hemer)

A95-73285* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE GRAVITATIONAL PLANT PHYSIOLOGY FACILITY-DESCRIPTION OF EQUIPMENT DEVELOPED FOR BIOLOGICAL RESEARCH IN SPACELAB
D. G. HEATHCOTE Univ. City Science Center, Philadelphia, PA, US, D. K. CHAPMAN Univ. of Pennsylvania, Philadelphia, PA, US, A. H. BROWN Univ. City Science Center, Philadelphia, PA, US, and R. F. LEWIS Univ. City Science Center, Philadelphia, PA, US
Microgravity Science and Technology (ISSN 0938-0108) vol. 7, no. 3 September 1994 p. 270-275
(Contract(s)/Grant(s): NAS2-10533; NAG2-574; NAG2-623)
(HTN-95-80713) Copyright

In January 1992, the NASA Suttle mission STS 42 carried a facility designed to perform experiments on plant gravi- and phototropic responses. This equipment, the Gravitational Plant Physiology Facility (GPPF) was made up of a number of interconnected units mounted within a Spacelab double rack. The details of these units and the plant growth containers designed for use in GPPF are described. The equipment functioned well during the mission and returned a substantial body of time-lapse video data on plant responses to tropistic stimuli under conditions of orbital microgravity. GPPF is maintained by NASA Ames Research Center, and is flight qualifiable for future spacelab missions. Author (Hemer)

N95-19969# Argonne National Lab., IL.
A PHOTOPHYSICAL CONTROL MECHANISM FOR ZEAXANTHIN-ASSOCIATED RADIATIONLESS ENERGY DISSIPATION IN PHOTOSYNTHESIS
HARRY A. FRANK (Connecticut Univ., Storrs, CT.), AGNES CUA (Connecticut Univ., Storrs, CT.), ANDREW YOUNG (Liverpool Univ., England.), DAVID GOSZTOLA, and MICHAEL R. WASIELEWSKI 1994 10 p
(Contract(s)/Grant(s): W-31-109-ENG-38)
(DE94-018383; ANL/CHM/CP-80107) Avail: CASI HC A02/MF A01

Understanding the way in which excess solar energy is dissipated by photosynthetic membranes under high light stress is a major problem in photosynthesis studies. This paper reports femtosecond time-resolved, fast-transient optical spectroscopic analyses of three important xanthophylls: violaxanthin, antheraxanthin, zeoaxanthin. The results support the notion that the enzymatic reactions that interconvert these xanthophylls act as a kind of 'molecular gear shift' controlling whether the molecules function as light-harvesting pigments performing forward energy transfer or as fluorescence quenchers performing reverse energy transfer. DOE

N95-20185# Massachusetts Inst. of Tech., Cambridge, MA. Artificial Intelligence Lab.
VIEWER-CENTERED OBJECT RECOGNITION IN MONKEYS
NIKOS LOGOTHETIS, J. PAULS, and TOMASO POGGIO Apr. 1994 21 p
(Contract(s)/Grant(s): N00014-93-I-0385)
(AD-A279876; AI-M-1473; CBCL-95) Avail: CASI HC A03/MF A01

How does the brain recognize three-dimensional objects? We trained monkeys to recognize computer rendered objects presented from an arbitrarily chosen training view, and subsequently tested their ability to generalize recognition for other views. Our results provide additional evidence in favor of a recognition model that accomplishes view-invariant performance by storing a limited number of object views or templates together with the capacity to interpolate between the templates. DTIC

N95-20208# Technische Hogeschool, Delft (Netherlands). Dept. of Biochemical Engineering.
PROCESS STRATEGIES IN THE ENZYMATIC RESOLUTION OF ENANTIOMERS Ph.D. Thesis
J. L. L. RAKELS 1 Jun. 1994 170 p
(PB95-107850) Avail: CASI HC A08/MF A02

Contents: General Introduction; A Simple Method to Determine the Enantiomeric Ration in Enantioselective Biocatalysis; Kinetic Analysis of Enzymatic Chiral Resolution by Progress Curve Evaluation; Kinetics of the Enzymatic Resolution of Racemic Compounds in Bi-bi Reactions; Modification of Enzyme Enantioselectivity by Product Inhibition; Comparison of Enzymatic Kinetic Resolution in a Batch Reactor and a CSTR; Strategies in the Preparation of Homochiral Compounds Using Combined Enantioselective Enzymes; Sequential Kinetic Resolution by two Enantioselective Enzymes; Improvement of Enzymatic Enantioselective Ester Hydrolysis in Organic Solvents; Improved Kinetic Resolution by Enzyme Catalyzed Parallel Reactions. NTIS

N95-20252 Battelle Memorial Inst., Research Triangle Park, NC.
THEORETICAL PREDICTION OF VIBRATIONAL CIRCULAR DICHROISM SPECTRA OF R-GLYCERALDEHYDE, R-ERYTHROSE, AND R-THREOSE. PART 2: DEVELOPMENT OF A PROCEDURE TO SCALE THE FORCE CONSTANT MATRIX EXPRESSED IN TERMS OF INTERNAL COORDINATES Final Report, May - Oct. 1992
DANIEL ZEROKA, JAMES O. JENSEN, and JANET L. JENSEN Nov. 1993 43 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(Contract(s)/Grant(s): DAAL03-91-C-0034; DA PROJ. 1O1-62622-A-553-C)
(AD-A284305; ERDEC-TR-112-PT-2) Avail: CASI HC A03

A very important objective of the Detection Directorate at the U.S. Army Edgewood Research, Development and Engineering Center is the remote detection of biological materials in the field. One line of thinking, currently being followed, is the recognition that sugars are distinguishing features of biological materials. In Part 1 of this study, the theoretical prediction of the vibrational circular dichroism (VCD) of the 3 and 4 carbon sugars R-glyceraldehyde, R-erythrose, and R-threose is considered. The calculational procedure used involves determination of the frequencies corresponding to the normal modes of vibration. Since calculated frequencies at the Hartree-Fock level are typically 10% too high, some form of scaling of the frequencies or the force constant matrix is required for quantitative agreement with experimental measurements. In Part 2 of this study, a scaling method is described, and three key FORTRAN computer programs are presented. Basically, the force constant matrix in internal coordinates at the 6-31G HF level of calculation is scaled to the calculated 6-31G MP2 level of calculation. The force constant matrix in terms of Cartesian coordinates can be determined from a matrix transformation, originally shown by Pulay, involving the force constant matrix in terms of internal coordinates. The scaling constant for each off-diagonal element of the force constant matrix was determined by using the geometric mean Q(sub ij) = ((Q sub i)(Q sub j))(exp 1/2) of the diagonal scaling constants (Q sub i) and (Q sub j). DTIC

N95-20471# National Renewable Energy Lab., Golden, CO.
ANAEROBIC DIGESTION ANALYSIS MODEL: USER'S MANUAL
M. RUTH and R. LANDUCCI Aug. 1994 79 p
(Contract(s)/Grant(s): DE-AC36-83CH-10093)
(DE94-011858; NREL/TP-421-6331) Avail: CASI HC A05/MF A01

The Anaerobic Digestion Analysis Model (ADAM) has been developed to assist investigators in performing preliminary economic analyses of anaerobic digestion processes. The model, which runs under Microsoft Excel(trademark), is capable of estimating the economic performance of several different waste digestion process configurations that are defined by the user through a series of option selections. The model can be used to predict required feedstock tipping fees, product selling prices, utility rates, and raw material unit costs. The model is intended to be used as a tool to perform preliminary economic estimates that could be used to carry out simple screening analyses. The model's current parameters are based on engineering judgments and are not reflective of any existing process; therefore, they should be carefully evaluated and modified if necessary to reflect the process under consideration. The accuracy and level of uncertainty of the estimated capital investment and operating costs are dependent on the accuracy and level of uncertainty of the model's input parameters. The underlying methodology is capable of producing results accurate to within +/- 30% of actual costs. DOE

N95-20559*# Texas Univ., San Antonio, TX. Dept. of Life Sciences.
MONOCLONAL ANTIBODIES DIRECTED AGAINST SURFACE MOLECULES OF MULTICELL SPHEROIDS Semiannual Progress Report, 1 Jul. - 31 Dec. 1994
ANDREW O. MARTINEZ 31 Dec. 1994 25 p
(Contract(s)/Grant(s): NAG2-819)
(NASA-CR-197367; NAS 1.26:197367) Avail: CASI HC A03/MF A01

The objective of this project is to generate a library of monoclonial antibodies (MAbs) directed against surface molecules of tumor and transformed cells grown as multicell spheroids (MCS). These MCS are highly organized, 3-dimensional multicellular structures which exhibit many characteristics of in vivo organized tissues which are not found in conventional monolayer or suspension culture. In brief, MCS combine the relevance or organized tissues with in vitro methodology making the MCS a good model system to study the interactions of mammalian cells, and thereby provide a functional assay for surface adhesion molecules. This project also involves investigations of cell-cell interactions in a gravity-based environment. It will provide an important base of scientific information for future comparative studies on the effects of hypergravity and simulated microgravity environments on cell-cell interactions. This project also has the potential to yield important materials (e.g. cellular products) which may be useful for the diagnosis and/or treatment of certain human diseases. Moreover, this project supports the training of one undergraduate and one graduate student; thus, it will also assist in developing a pool of future scientists with research experience in gravitational biology research. Author

N95-20711 Texas A&M Univ., College Station, TX.
BACTERIAL LUCIFERASE: DETERMINATION OF THE STRUCTURE BY X-RAY DIFFRACTION Final Report, 1 May 1992 - 31 Dec. 1993
MIRIAM M. ZIEGLER and THOMAS O. BALDWIN 20 May 1994 73 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(Contract(s)/Grant(s): N00014-92-J-1900)
(AD-A279699) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

This project was focused on determination of the three-dimensional structure of bacterial luciferase. The structure of the enzyme is of fundamental importance to the understanding of the catalytic mechanism and the mode of interaction of the enzyme with accessory proteins, and is essential to future plans to develop biosensor technologies. In the course of this project, numerous crystallization trials were carried out and conditions were refined that permitted high resolution data to be collected and interpreted. In collaboration with Dr. Ivan Rayment of the University of Wisconsin, data have been collected from native crystals and 3 derivatives at 2.8 A. Higher resolution data are being collected at this time, and we fully expect to have a high resolution structure within the next few months, certainly by the end of the calendar year 1994. We have also developed crystallization protocols for several mutant luciferases. Structural analysis of the mutant luciferases should enable us to locate the active site in the three-dimensional structure of the wild-type enzyme, permit mechanistic interpretation of numerous experiments that have been reported over the past ca. 25 years, and assist us in designing the next generation of mutant enzymes to test hypotheses regarding the mechanism of light production by this intriguing and important enzyme. DTIC

N95-20806# Texas Univ. Health Science Center, San Antonio, TX. Dept. of Radiology.
IN VIVO DISTRIBUTION OF LIPOSOME ENCAPSULATED HEMOGLOBIN STUDIED WITH IMAGING RADIOTRACERS Final Technical Report, 1 Dec. 1990 - 31 Mar. 1994
WILLIAM T. PHILLIPS 31 Mar. 1994 117 p
(Contract(s)/Grant(s): N00014-91-J-1217)
(AD-A279774) Avail: CASI HC A06/MF A02

The objective of this project was to develop radiotracer imaging technology to follow the in vivo circulation and organ deposition of liposome encapsulated hemoglobin (LEH). A liposome labeling technique based on the most common radioisotope used in nuclear medicine, technetium-99m (99m Tc), was developed and patented. A comparison of this 99mTc-liposome labeling method with previous methods using indium-111 (In-111) was performed. The label LEH was infused into small animals to monitor any in vivo differences between different LEH formulations (bovine hemoglobin, recombinant human hemoglobin, human hemolysate, lyophilized) using gamma scintigraphy and tissue biodistribution determination. These studies were correlated with any hematological and pathological changes associated with LEH treatment such as the interaction of LEH with circulating platelets using indium-111-labeled platelets. DTIC

N95-20917# Georgia Univ., Athens, GA. Dept. of Biochemistry.
MICROBIOLOGY AND PHYSIOLOGY OF ANAEROBIC FERMENTATIONS OF CELLULOSE
H. D. PECK, JR., L. G. LJUNGDAHL, L. E. MORTENSON, and J. K. W. WIEGEL 1994 26 p
(Contract(s)/Grant(s): DE-FG09-86ER-13614)
(DE95-002899; DOE/ER-13614/T1) Avail: CASI HC A03/MF A01

This project studies the biochemistry and physiology of four major groups (primary, secondary, ancillary and methane bacteria) of anaerobic bacteria, that are involved in the conversion of cellulose to methane or chemical feedstocks. The primary bacterium, Clostridium thermocellum, has a cellulolytic enzyme system capable of hydrolyzing crystalline cellulose and consists of polypeptide complexes attached to the substrate cellulose with the aid of a low molecular yellow affinity substance (YAS) produced by the bacterium in the presence of cellulose. Properties of the complexes and YAS are studied. Aspects of metabolism are being studied which appear to be relevant for the interactions on consortia and their bioenergetics, particularly related to hydrogen, formate, CO, and CO2. The roles of metals in the activation of H2 are being investigated, and genes for the hydrogenases cloned and sequenced to established structural relationships among the hydrogenases. The goals are to understand the roles and regulation of hydrogenases in interspecies H2 transfer, H2 cycling and the generation of a proton gradient. The structures of the metal clusters and their role in the metabolism of formate will be investigated with the goal of understanding the function of formate in the total synthesis of acetate from CO2 and its role in the bioenergetics of these mi croorganisms. Additionally, the enzyme studies will be performed using thermophiles and also the isolation of some new pertinent species. The project will also include research on the mechanism of extreme thermophily (growth over 70 deg) in bact eria that grow over a temperature span of 40C or more. These bacteria exhibit a biphasic gr owth response to

temperature and preliminary evidence suggests that the phenomenon is due to the expression of a new set of enzymes. These initial observations will be extended employing techniques of molecular biology. DOE

N95-21112# Helsinki Univ. of Technology, Espoo (Finland). Lab. of Computer and Information Science.
ATTEMPT TO INTERPRET THE SELF-ORGANIZING MAPPING PHYSIOLOGICALLY
TEUVO KOHONEN Nov. 1993 24 p
(ISSN 0783-7445)
(PB95-127783; ISBN-951-22-1291-9) Avail: CASI HC A03/MF A01

It is argued that the Self-Organizing Map (SOM) may be implemented in biological neural networks by partly neural, partly chemical mechanisms. For the Winner Take All function a laterally connected network seems proper. The active forgetting relating to the automatic normalization of the synaptic strengths in learning is thought to ensure from competition on postsynaptic resources. The neighborhood function needed in the SOM algorithm is most effectively implemented by chemical agents, which are formed or released in the neighborhood of highly active cells. These agents are thought to control the synaptic plasticity. Such a physiological model then behaves in the same way as the idealized SOM algorithm, which has been found very effective in many information-processing applications. NTIS

N95-21366# Los Alamos National Lab., NM.
POTENTIAL-OF-MEAN-FORCE DESCRIPTION OF IONIC INTERACTIONS AND STRUCTURAL HYDRATION IN BIOMOLECULAR SYSTEMS
G. HUMMER, A. E. GARCIA, and D. M. SOUMPASIS (Max-Planck-Inst. fuer Biophysikalische Chemie, Goettingen, Germany.) 1994 18 p Presented at the Non-Linear Exitations in Biomolecules, Houches, France, 30 May - 4 Jun. 1994
(Contract(s)/Grant(s): W-7405-ENG-36)
(DE95-000859; LA-UR-94-3139; CONF-9405240-2) Avail: CASI HC A03/MF A01

To understand the functioning of living organisms on a molecular level, it is crucial to dissect the intricate interplay of the immense number of biological molecules. Most of the biochemical processes in cells occur in a liquid environment formed mainly by water and ions. This solvent environment plays an important role in biological systems. The potential-of-mean-force (PMF) formalism attempts to describe quantitatively the interactions of the solvent with biological macromolecules on the basis of an approximate statistical-mechanical representation. At its current status of development, it deals with ionic effects on the biomolecular structure and with the structural hydration of biomolecules. The underlying idea of the PMF formalism is to identify the dominant sources of interactions and incorporate these interactions into the theoretical formalism using PMF's (or particle correlation functions) extracted from bulk-liquid systems. In the following, the authors shall briefly outline the statistical-mechanical foundation of the PMF formalism and introduce the PMF expansion formalism, which is intimately linked to superposition approximations for higher-order particle correlation functions. The authors shall then sketch applications, which describe the effects of the ionic environment on nucleic-acid structure. Finally, the authors shall present the more recent extension of the PMF idea to describe quantitatively the structural hydration of biomolecules. Results for the interface of ice and water and for the hydration of deoxyribonucleic acid (DNA) will be discussed. DOE

N95-21376# Argonne National Lab., IL. Genome Structure Group.
PROPOSAL FOR A TUTORIAL ON MINIMAL LENGTH ENCODING (MLE) IN MOLECULAR BIOLOGY
ALEKSANDAR MILOSAVLJEVIC Mar. 1994 6 p Presented at the 2nd International Conference on Intelligent Systems for Molecular Biology, Stanford, CA, 15-17 Aug. 1994
(Contract(s)/Grant(s): W-31-109-ENG-38)
(DE94-015076; ANL/CMB/CP-82418; CONF-9408117-1) Avail: CASI HC A02/MF A01

This paper describes a tutorial to introduce the Minimal length encoding (MLE) method to computational biologists who are designing sequence analysis algorithms, to computer scientists who are interested in learning more about macromolecular sequence analysis, and to biologists who are more advanced users of the sequence analysis programs. An emphasis of the workshop will be on the use of the MLE method as a tool for comparative analysis of inference programs in computational biology, with an ultimate purpose of providing more methodological coherence to the emerging field of computational biology. DOE

N95-21526# Georgia Univ., Athens, GA. Dept. of Botany.
NITROGEN CONTROL OF CHLOROPLAST DIFFERENTIATION
GREGORY W. SCHMIDT 1994 6 p
(Contract(s)/Grant(s): DE-FG09-84ER-13188)
(DE95-002797; DOE/ER-13188/9) Avail: CASI HC A02/MF A01

This project was directed toward understanding how the availability of nitrogen affects the accumulation of chloroplast pigments and proteins that function in energy transduction and carbon metabolism. The availability of this nutrient most pervasively limits plant growth and agricultural productivity but the molecular and physiological consequences of nitrogen-deficiency are poorly understood. The model system for our studies of nitrogen-dependent regulation of chloroplast differentiation is the unicellular green alga Chlamydomonas reinhardtii which is grown phototrophically in a continuous culture system. When 150 micrometers nitrogen is provided at a dilution rate of 0.25 volumes of the growth medium per day, the cultures are sustained at a density of less than 10(exp 5) cells/ml and chlorophyll deficiency, the classical symptom of nitrogen-deficiency, becomes quite pronounced. We found that there is a concomitant loss of light-harvesting complexes and reduced levels of Photosystem II reaction center complexes while ATP synthetase and Photosystem I reaction centers are maintained at high levels. Moreover, reduced rates of chloroplast protein synthesis are due to differential effects on mRNA translation. In contrast, the deficiency of light-harvesting genes is due to marked reductions of the nuclear-encoded cab mRNA's. Although there is no significant reduction of the amounts of RuBPCase, we also detected substantial changes in the mRNA abundance of the alga's two small subunit genes. All of the effects of nitrogen-limitation are readily reversible: greening of cells is completed within 24 hours after provision of 10 mM ammonium. During this time, the plastid translational constraints are disengaged and progressive changes in the abundance of nuclear transcripts occur, including a transient 30-fold elevation of (und cab) mRNA's. DOE

N95-21529*# Universities Space Research Association, Columbia, MD.
ANNUAL PROGRAM ANALYSIS OF THE NASA SPACE LIFE SCIENCES RESEARCH AND EDUCATION SUPPORT PROGRAM Report, 1 Dec. 1993 - 30 Nov. 1994
30 Nov. 1994 42 p
(Contract(s)/Grant(s): NAS9-18440)
(NASA-CR-197298; NAS 1.26:197298) Avail: CASI HC A03/MF A01

The basic objectives of this contract are to stimulate, encourage, and assist research and education in NASA life sciences. Scientists and experts from a number of academic and research institutions in this country and abroad are recruited to support NASA's need to find a solution to human physiological problems associated with living and working in space and on extraterrestrial bodies in the solar system. To fulfill the contract objectives, a cadre of staff and visiting scientists, consultants, experts, and subcontractors has been assembled into a unique organization dedicated to the space life sciences. This organization, USRA's Division of Space Life Sciences, provides an academic atmosphere, provides an organizational focal point for science and educational activities, and serves as a forum for the participation of eminent scientists in the

biomedical programs of NASA. The purpose of this report is to demonstrate adherence to the requirement of Contract NAS9-18440 for a written review and analysis of the productivity and success of the program. In addition, this report makes recommendations for future activities and conditions to further enhance the objectives of the program and provides a self-assessment of the cost performance of the contract. Derived from text

N95-21544*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
HYPERVOLEMIA IN MEN FROM DRINKING HYPERHYDRATION FLUIDS AT REST AND DURING EXERCISE
J. E. GREENLEAF, R. LOOFTWILSON, P. P. WISHERD, P. P. FUNG, A. C. ERTL, C. G. R. JACKSON, P. R. BARNES, and L. G. WONG (Shaklee US, Inc., San Francisco, CA.) Dec. 1994 55 p
(Contract(s)/Grant(s): RTOP 199-18-12-07)
(NASA-TM-4657; A-94138; NAS 1.15:4657) Avail: CASI HC A04/MF A01

To test the hypothesis that drink composition is more important than drink osmolality (Osm) for maintaining and increasing plasma volume (PV) at rest and during exercise, six men (22-39 yr, 76.84 +/- 16.19 kg, 2.99 +/- 0.45 L/min VO2 peak) each underwent six treatments while sitting for 90 min (VO2 = 0.39 L/min) and then performed upright ergometer exercise for 70 min (VO2 = 2.08 +/- 0.33 1/min, 70% +/- 7% VO2 peak). Drink formulations (10 ml/kg body weight, X = 768 ml) for the sitting period were: P1 (55 mEq Na(+), 365 mOsm/kg H2O), P2 (97.1 mEq Na(+), 791 mOsm/kg), P2G (113 mEqNa(+), 80 ml glycerol, 1,382 mOsm/kg, HyperAde (HA) (164 mEq Na(+), 253 mOsm/kg), and 01 and 02 (no drinking). The exercise drink (10 ml/kg, 768 ml) was P1 for all treatments except 02. Plasma volume at rest increased (p less than 0.05) by 4.7% with P1 and by 7.9% with HA. Percent change in PV during exercise was +1% to +3%0(NS) with HA; -6% to 0% (NS) with P1, P2, P2G, and 01; and -8% to -5% (p less than 0.05) with 02. HyperAde, with the lowest osmolality (253 mOsm/kg), maintained PV at rest and during exercise, whereas the other drinks with lower Na(+) and higher osmolality (365 to 1,382 mOsm/kg) did not. But Performance 1 also increased PV at rest. Thus, drink composition may be more important than drink osmolality for increasing plasma volume at rest and for maintaining it during exercise. Author

N95-21548# Oak Ridge National Lab., TN.
CELL MEMBRANE POTENTIALS INDUCED DURING EXPOSURE TO EMP FIELDS
P. C. GAILEY and C. E. EASTERLY 1994 8 p Presented at the Theater Nuclear Warfare Program, Williamsburg, VA, 16-18 Mar. 1993
(Contract(s)/Grant(s): DE-AC05-84OR-21400)
(DE94-018952; CONF-9303304-1) Avail: CASI HC A02/MF A01

Internal current densities and electric fields induced in the human body during exposure to EMP fields are reviewed and used to predict resulting cell membrane potentials. Using several different approaches, membrane potentials of about 100 mV are predicted. These values are comparable to the static membrane potentials maintained by cells as a part of normal physiological function, but the EMP-induced potentials persist for only about 10 ns. Possible biological implications of EMP-induced membrane potentials including conformational changes and electroporation are discussed. DOE

N95-21606# Oak Ridge National Lab., TN.
THE MOLECULAR MECHANICS PROGRAM DUPLEX: COMPUTING STRUCTURES OF CARCINOGEN MODIFIED DNA BY SURVEYING THE POTENTIAL ENERGY SURFACE
B. E. HINGERTY and S. BROYDE (New York Univ., New York, NY.) 1994 16 p Presented at the 27th Jerusalem Symposium in Quantum Chemistry and Biochemistry, Jerusalem, Israel, 23-26 May 1994
(Contract(s)/Grant(s): DE-AC05-84OR-21400; DE-FG02-90ER-60931)
(DE94-019153; CONF-9405196-2) Avail: CASI HC A03/MF A01

The nucleic acids molecular mechanics program DUPLEX has been designed with useful features for surveying the potential energy surface of polynucleotides, especially ones that are modified by polycyclic aromatic carcinogens. The program features helpful strategies for addressing the multiple minimum problem: (1) the reduced variable domain of torsion angle space; (2) search strategies that emphasize large scale searches for smaller subunits, followed by building to larger units by a variety of strategies; and (3) the use of penalty functions to aid the minimizer in locating selected structural types in first stage minimizations (penalty functions are released in terminal minimizations to yield final unrestrained minimum energy conformations). Predictive capability is illustrated by DNA modified by activated benzo(a)pyrenes. DOE

N95-21884# Rijksinstituut voor Volksgezondheid en Milieuhygieene, Bilthoven (Netherlands).
EFFECTS OF INCREASED UV-B RADIATION ON PHYTOPLANKTON: A PRELIMINARY STUDY AND RESEARCH PROGRAMME ARNOLD VEEN
Feb. 1993 32 p See also DE88-753545 Sponsored by Dutch National Research Programme on Global Air Pollution and Climate Change
(PB95-133732; RIVM-731054001) Avail: CASI HC A03/MF A01

The depletion of the ozone layer through actions of, for instance, chlorine containing catalysts is expected to result in an increased UV-B irradiance. Since phytoplankton is known to be sensitive to this radiation, effects on global primary production cannot be excluded. The preliminary results in semi-continuous culture experiments indicated that algae differ widely in their response to UV-B radiation. Desmid and diatom species were much more sensitive than green algae. Furthermore, the experiments emphasized the importance of an accurate dosimetry, so the next step was to build a continuous culture system with steering software to simulate natural photosynthetic light regimes and UV-B simultaneously, and study the effect on growth rate and other physiological parameters. The culture system was designed to allow for exact quantification of the UV-B exposure. Finally a list of publications is presented that were necessary to build the system and its steering components, and gave background information on reactions of both photosynthetic light and UV-B radiation on phytoplankton. NTIS

N95-22065# Los Alamos National Lab., NM.
LIFE SCIENCES DIVISION AND CENTER FOR HUMAN GENOME STUDIES Progress Report, 1992-1993
MORTON BRADBURY,comp., SCOTT CRAM, comp., and CAROLYN STAFFORD, comp. Jul. 1994 94 p
(Contract(s)/Grant(s): W-7405-ENG-36)
(DE94-017796; LA-12754-PR) Avail: CASI HC A05/MF A01

This report summarizes the research and development activities of the Los Alamos National Laboratory's Life Sciences Division and the biological aspects of the Center for Human Genome Studies for the calendar years 1992 and 1993. The technical portion of the report is divided into two parts: (1) selected research highlights; and (2) research projects and accomplishments. The research highlights provide a more detailed description of a select set of projects. A technical description of all projects is presented in sufficient detail to permit the informed reader to assess their scope and significance. Summaries useful to the casual reader desiring general information have been prepared by the group leaders and appear in each group overview. Investigators on the staff of Life Sciences Division will be pleased to provide further information. DOE

N95-22066# Carnegie Institution of Washington, Stanford, CA. Dept. of Plant Biology.
THE USE OF CYANOBACTERIA TO EXPLORE BASIC BIOLOGICAL PROCESSES Abstracts Only
ARTHUR R. GROSSMAN 1994 113 p Workshop held in Pacific Grove, CA, 30 May - 2 Jun. 1993
(Contract(s)/Grant(s): DE-FG02-93ER-20112; NSF MCB-93-04625;

USDA-9301106)
(DE94-019238; CONF-9305375-ABSTS) Avail: CASI HC A06/MF A02

This volume contains the proceedings of The Cyanobacteria Workshop, 1993 held at the Asilomar Conference Center in Pacific Grove, California May 30—June 2, 1993. The volume contains single page abstracts of forty-one presentations made at the meeting organized under the topics addressed by the meeting: (1) Photosynthesis; (2) Nitrogen Metabolism and Heterocyst Differentiation; (3) Nutrient Stress Responses and Metabolic Processes; (4) The Phycobilisome; and (5) Miscellaneous Topics. DOE

N95-22067# Argonne National Lab., IL.
DISCOVERING RELATED DNA SEQUENCES VIA MUTUAL INFORMATION
A. MILOSAVLJEVIC 1994 17 p
(Contract(s)/Grant(s): W-31-109-ENG-38; DE-FG03-91ER-61152)
(DE95-001101; ANL/CMB/PP-81002) Avail: CASI HC A03/MF A01

One of the problems in DNA and protein sequence comparisons is to decide whether the observed similarity should be explained by their relatedness or by the mere presence of some shared internal structure, e.g., shared internal repetitive patterns. Machine discovery of related DNA sequences critically depends on a solution to this problem. In this paper we propose a general solution that is based on minimal length encoding: we measure mutual information between two sequences as the difference between the encoding length of one of the sequences sequence and its encoding length relative to the other sequence; two sequences are considered similar if the mutual information exceeds a threshold of significance; the significance is determined using an extension of the newly proposed algorithmic significance method. We show that mutual information factors out sequence similarity that is due to shared internal structure and thus enables discovery of truly related sequences. In addition to this general method, we also propose an efficient way to compare sequences based on their subword composition that does not require any a priori assumptions about k-tuple length. DOE

N95-22075# Argonne National Lab., IL.
ELECTROSTATIC BASIS FOR MOLECULAR RECOGNITION IN PHOTOSYNTHESIS
D. M. TIEDE, A. C. VASHISTA, and M. R. GUNNER (City Coll. of the City Univ. of New York, NY.) 1994 6 p
(Contract(s)/Grant(s): W-31-109-ENG-38)
(DE95-002979; ANL/CHM/PP-79997) Avail: CASI HC A02/MF A01

An electrostatic basis for molecular recognition in photosynthesis has been found, based upon calculations from the crystal structure of the Rhodobacter sphaeroides photosynthetic reaction center, and supported by experimental measurements of water-soluble c-cytochrome docking on the reaction center. Besides providing a physical explanation for molecular recognition in photosynthesis, this work is significant because it is a starting point for the examination of the role for electrostatics in the incorporation of membrane proteins into crystals and other ordered arrays that have potential for molecular device applications. Solar energy conversion in photosynthesis requires that reactive, bimolecular electron-transfer complexes are formed between the reaction center, the protein that carries out the initial conversion of solar energy to chemical energy, and specific secondary electron donors and acceptors. The molecular basis for recognition between the reaction center and its photosynthetic partners is determined by the charge and chemical properties of the associated proteins. This work identified a likely electrostatic mechanism for assembly of electron transfer complexes between the reaction center from Rb. sphaeroides and a series of structurally homologous water-soluble c-cytochromes by identifying correlations between electron transfer and electrostatic properties of the reaction center and the various c-cytochromes. The kinetics of electron transfer between the reaction center and nine soluble c-cytochromes were analyzed and compared to the patterns of the surface electrostatic potentials for each of the proteins. DOE

N95-22220 Georgia Univ., Athens, GA. Complex Carbohydrate Research Center.
STRUCTURES AND FUNCTIONS OF OLIGOSACCHARINS
P. ALBERSHEIM Oct. 1994 12 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(Contract(s)/Grant(s): DE-FG09-85ER-13425)
(DE95-003195; DOE/ER-13425/T4) Avail: CASI HC A03

This document contain abstracts of 25 papers published or in preparation describing the structure and function of oligosaccharins. Research is described in the following areas: Phytotoxic effects of microbial pectic enzymes; Fungal enzymes, plant cell wall fragments, and plant cell death; Roles of cell wall constituents in plant-pathogen interactions; The control of morphogenesis in tobacco thin cell-layer explants; Studies of the ability of xyloglucan oligosaccharides to inhibit auxin-stimulated growth; and Oligosaccharins - oligosaccharides that regulate growth, development, and defence responses in plants. DOE

N95-22296# Los Alamos National Lab., NM.
FLOW CYTOMETRY: A POWERFUL TECHNOLOGY FOR MEASURING BIOMARKERS
J. H. JETT 1994 17 p Presented at the Workshop on Development and Application of Biomarkers, Santa Fe, NM, 26-29 Apr. 1994
(Contract(s)/Grant(s): W-7405-ENG-36)
(DE94-018284; LA-UR-94-2831; CONF-9404178-1) Avail: CASI HC A03/MF A01

A broad definition of a biomarker is that it is a measurable characteristic of a biological system that changes upon exposure to a physical or chemical insult. While the definition can be further refined, it is sufficient for the purposes of demonstrating the advantages of flow cytometry for making quantitative measurements of biomarkers. Flow cytometry and cell sorting technologies have emerged during the past 25 years to take their place alongside other essential tools used in biology such as optical and electron microscopy. This paper describes the basics of flow cytometry technology, provides illustrative examples of applications of the technology in the field of biomarkers, describes recent developments in flow cytometry that have not yet been applied to biomarker measurements, and projects future developments of the technology. The examples of uses of flow cytometry for biomarker quantification cited in this paper are meant to be illustrative and not exhaustive in the sense of providing a review of the field. DOE

N95-22397 American Association for Cancer Research, Philadelphia, PA.
CELLULAR RESPONSES TO ENVIRONMENTAL DNA DAMAGE
1994 245 p Presented at the AACR Conference in Cancer Research: Cellular Responses To Environmental DNA Damage, Banff, Alberta, 1-6 Dec. 1991 Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(Contract(s)/Grant(s): DE-FG02-92ER-61370)
(DE94-015606; DOE/ER-61370/1; CONF-9112182) Avail: CASI HC A11

This volume contains the proceedings of the conference entitled Cellular Responses to Environmental DNA Damage held in Banff, Alberta December 1-6, 1991. The conference addresses various aspects of DNA repair in sessions titled: DNA repair; Basic Mechanisms; Lesions; Systems; Inducible Responses; Mutagenesis; Human Population Response Heterogeneity; Intragenomic DNA Repair Heterogeneity; DNA Repair Gene Cloning; Aging; Human Genetic Disease; and Carcinogenesis. Individual papers are represented as abstracts of about one page in length. DOE

52
AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

A95-71340
A REVIEW OF MUSCLE ATROPHY IN MICROGRAVITY AND DURING PROLONGED BED REST
PIETER M. DROPPERT University of Manchester, Manchester, England British Interplanetary Society, Journal (ISSN 0007-094X) vol. 46, no. 3 March 1993 p. 83-86
(HTN-95-90825) Copyright

With the prospect of long duration space missions in Earth orbit or to Mars, there is a need for adequate information on the physiological adaptations that will occur. One consequence of prolonged exposure to microgravity in muscle atrophy (loss of muscle mass). After a long duration space flight, muscle atrophy along with skeletal calcium loss would affect the capacity of astronauts to re-adapt to gravity on return to Earth. Of importance are any countermeasures which can attenuate the adaptive responses to microgravity. Experimentation is difficult in space with small subject numbers and mission constraints. Prolonged bed rest using healthy volunteers is used as an Earth-based model to simulate the muscle atrophy which occurs in the microgravity environment. Author (Herner)

A95-71341
PREDICTING SKELETAL ADAPTATION IN ALTERED GRAVITY ENVIRONMENTS
TONY S. KELLER University of Vermont, Burlington, VT, US and ALVIN M. STRAUSS Vanderbilt University, Nashville, TN, US British Interplanetary Society, Journal (ISSN 0007-094X) vol. 46, no. 3 March 1993 p. 87-96 Research sponsored by the Department of Veterans Affairs Medical Center
(HTN-95-90826) Copyright

It is generally agreed that the single factor that most limits human survivability in non-Earth environments is the phenomenon of bone demineralization and the medical problems induced by the subsequent imbalance in the calcium metabolism. Alterations of skeletal properties occur as a result of disturbances in the normal mechanical loading environment of bone. These alterations or 'adaptations' obey physical laws, but the precise mathematical relationships remain to be determined. Principles governing unloading and overloading of bone are gaining more attention as a consequence of the planning of manned space stations, moon and Mars bases and spaceflights of long duration. This paper reviews the subject of bone remodeling and presents a mathematical framework which allows for the prediction of skeletal adaptation on Earth and in non-Earth gravity environments by power law relationships. Author (Herner)

A95-71342
THE EFFECTS OF PROLONGED WEIGHTLESSNESS AND REDUCED GRAVITY ENVIRONMENTS ON HUMAN SURVIVAL
RICHARD L. S. TAYLOR University of London, UK British Interplanetary Society, Journal (ISSN 0007-094X) vol. 46, no. 3 March 1993 p. 97-106
(HTN-95-90827) Copyright

The manned exploration of the solar system and the surfaces of some of the smaller planets and larger satellites requires that we are able to keep the adverse human physiological response to long term exposure to near zero and greatly reduced gravity environments within acceptable limits consistent with metabolic function. This paper examines the physiological changes associated with microgravity conditions with particular reference to the weightless demineralization of bone (WDB). It is suggested that many of these changes are the result of physical/mechanical processes and are not primarily a medical problem. There are thus two immediately obvious and workable, if relatively costly, solutions to the problem of weightlessness. The provision of a near 1 g field during prolonged space flights, and/or the development of rapid transit spacecraft capable of significant acceleration and short flight times. Although these developments could remove or greatly ameliorate the effects of weightlessness during long-distance space flights there remains a problem relating to the long term colonization of the surfaces of Mars, the Moon, and other small solar system bodies. It is not yet known whether or not there is a critical threshold value of 'g' below which viable human physiological function cannot be sustained. It such a threshold exists permanent colonization may only be possible if the threshold value of 'g' is less than that at the surface of the planet on which we wish to settle. Author (Herner)

A95-71755
SELF-REGULATED INSULIN DELIVERY SYSTEM USING BORONIC ACID GEL
DAIJIRO SHIINO Int Cent for Biomaterials Science (ICBS), Chiba, Japan, KAZUNORI KATAOKA, YOSHIYUKI KOYAMA, MASAYUKI YOKOYAMA, TERUO OKANO, and YASUHISA SAKURAI Journal of Intelligent Material Systems and Structures (ISSN 1045-389X) vol. 5, no. 3 May 1994 p. 311-314 refs
(BTN-94-EIX94381359518) Copyright

A novel polymer system sensitive to glucose concentration has been studied as a candidate material for chemically regulated insulin release system. Phenylboronic acid is able to form reversible binding to cis-diol substances. A glucose responsive insulin release system has been studied with utilization of phenylboronic acid polymers for the key material in the exchange reaction between gluconic acid modified insulin (G-Ins) and glucose. The released concentration of G-Ins from the polymer was pulsatile in response to the repeated stepwise concentration changes of glucose. The linearity between glucose concentration and peak height of released G-Ins and the release response demonstrated no lag time to changes in glucose concentration were other important finites. The phenylboronic acid polymer shows considerable promise for use in a self-regulating insulin delivery system. Author (EI)

A95-73280
CRYSTALLIZATION OF THE EGF RECEPTOR ECTODOMAIN ON US SPACE MISSION STS-47
CHR. BETZEL EMBL-Outstation, Hamburg, Germany, N. GUNTHER Univ. Eppendorf, Hamburg, Germany, S. POLL Univ. Eppendorf, Hamburg, Germany, K. MOORE Center for Macromolecular Crystallography, Birmingham, AL, US, L. J. DELUCAS Center for Macromolecular Crystallography, Birmingham, AL, US, CH. E. BUGG Center for Macromolecular Crystallography, Birmingham, AL, US, and W. WEBER Univ. Eppendorf, Hamburg, Germany Microgravity Science and Technology (ISSN 0938-0108) vol. 7, no. 3 September 1994 p. 242-245 Research sponsored by DFG and DARA
(HTN-95-80708) Copyright

Although biochemists working in the field of biological signal transduction have characterized cell surface receptors for numerous growth factors within the past ten years, none of the three-dimensional structures could be obtained for these important proteins which represent major components of the cells' growth control system. Now, the extracellular ligand binding domain of the EGF receptor was crystallized in the presence of EGF under microgravity on the US Shuttle mission STS-47. In 8 out of 9 experiments prepared under different conditions crystal growth was observed. One of these spacegrown crystals showed higher diffraction quality than all crystals previously obtained in the laboratory. It allowed, for the first time, evaluation of the real space group by partial data collection. Author (Herner)

A95-73284* National Aeronautics and Space Administration, Washington, DC.
EFFECT OF MICROGRAVITY ON COLLAGENASE DEPROTOEINIZATION AND EDTA DECALCIFICATION OF BONE FRAGMENTS
S. J. SIMSKE Univ. of Colorado, Boulder, CO, US and M. W. LUTTGES Univ. of Colorado, Boulder, CO, US Microgravity Science and Technology (ISSN 0938-0108) vol. 7, no. 3 September 1994 p. 266-269

(Contract(s)/Grant(s): NAGW-1197)
(HTN-95-80712) Copyright

Undecalcified (n = 140) and decalcified (n = 11) bone fragments were treated with either collagenase (to remove collagen portion; undecalcified n = 64, decalcified n = 11) or EDTA (to remove mineral portion; n= 76) under the reduced gravity environment on US Space Shuttle mission STS-57. The fragments were initially stored in Dulbecco's phosphate buffer solution. After orbit had been established, fragments were exposed to either a neutral buffered collagenase or EDTA solution. Reactions were terminated (neutral buffered formalin for collagenase, 21% CuSO4-5H2O for EDTA) before reentry to earth's atmosphere. Differences in bone samples mass from before flight to after flight were measured. EDTA-treated sample mass was corrected for CuSO4 content. Flight and matched ground (gravitational control) sample showed similar EDTA-induced loss of mineral mass. Collagenase treatments, however, appeared to be more effective in flight samples compared to ground control samples. The flight-exposed, collagenase-treated samples showed significantly more loss than did ground samples. The microgravity environment appeared to promote proteolytic reactions in bone more than the EDTA decalcification reaction. Author (Herner)

N95-19898# Wyoming Univ., Laramie, WY. Dept. of Molecular Biology.
USAF CELLULAR MECHANISM OF TURNOVER OF THE STRESS INDUCED PROTEIN HSP70 Final Report, 15 Apr. 1983 - 14 Apr. 1994
NANCY S. PETERSEN 14 Apr. 1994 11 p
(Contract(s)/Grant(s): F49620-92-J-0234)
(AD-A285618; AFOSR-94-0480TR) Avail: CASI HC A03/MF A01

Because heat shock proteins are made by all organisms in response to environmental stress, it has been proposed that accumulation of these proteins could be useful in environmental monitoring. In order to use the accumulation of heat shock proteins as indicators of environmental stress, it is important to understand how their stability is regulated. This research is concerned with determining the influences that regulate the stability of the major heat shock protein, hsp7O, in rainbow trout (used for environmental monitoring) and in fruit files (a well characterized system used for basic research). During the tenure of this grant progress has been made characterizing the rainbow trout heat shock response, cloning and sequencing the rainbow trout heat shock gene, and in generating antibodies specific for fruit fly and rainbow trout hsp7O. The accumulation of hsp7O in juvenile rainbow trout exposed to heavy metals has been assessed in collaboration with the H. Berman Lab. Commercially available antibodies have been used to identify hsp7O breakdown products in flies, trout, chick, and mouse, and the sequences of the major breakdown fragments of the fly hsp7O generated in vivo have been determined. DTIC

N95-20074# Argonne National Lab., IL.
THORIUM-232 IN HUMAN TISSUES: METABOLIC PARAMETERS AND RADIATION DOSES
A. F. STEHNEY 1994 58 p
(Contract(s)/Grant(s): W-31-109-ENG-38)
(DE94-019275; ANL/BIM/PP-70108) Avail: CASI HC A04/MF A01

Higher than environmental levels of Th-232 have been found in autopsy samples of lungs and other organs from four former employees of a Th refinery. Working periods of the subjects ranged from 3 to 24 years, and times from end of work to death ranged from 6 to 31 years. Concentrations of Th-232 in these samples and in tissues from two cases of non-occupational exposure were examined for compatibility with dosimetric models in Publication 30 of the International Commission on Radiological Protection (ICPP 1979a). The concentrations of Th-232 in the lungs of the Th workers relative to the concentrations in bone or liver were much higher than calculated from the model for class Y aerosols of Th and the exposure histories of the subjects, and concentrations in the pulmonary lymph nodes were much lower than calculated for three of the Th workers and both non-occupational cases. Least-squares fits to the measured concentrations showed that the biological half-times of Th in liver, spleen, and kidneys are similar to the half-time in bone instead of the factor of 10 less suggested in Publication 30, and the fractions translocated from body fluids were found to be about 0.03, 0.02, and 0.005, respectively, when the fraction to bone was held at the suggested value of 0.7. Fitted values of the respiratory parameters differed significantly between cases and the differences were ascribable to aerosol differences. Average inhalation rates calculated for individual Th workers ranged from 50 to 110 Bq Th-232 y(sup -1), and dose equivalents as high as 9.3 Sv to the lungs, 2.0 Sv to bone surfaces, and 1.1 Sv effective dose equivalent were calculated from the inhalation rates and fitted values of the metabolic parameters. The radiation doses were about the same when calculated from parameter values fitted with an assumed translocation fraction of 0.2 from body fluids to bone instead of 0.7. DOE

N95-20301 North Dakota State Univ., Fargo, ND.
A PHYSIOLOGICAL NEURAL NETWORK FOR SACCADIC EYE MOVEMENT CONTROL Final Report, 26 Feb. 1991 - 1 Feb. 1994
JOHN D. ENDERLE Apr. 1994 56 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(Contract(s)/Grant(s): F33615-90-D-0606)
(AD-A279599; AL/AO-TR-1994-0023) Avail: CASI HC A04

Based on electrophysiological evidence, eye-movement measurements and systems control theory, a new physiological neural network model of horizontal saccadic control is described. The neural control mechanism is first-order, time-optimal, and is initiated by the deep layers of the superior colliculus and terminated by the cerebellar fastigial nucleus. The neural circuit consists of neurons in the paramedian pontine reticular formation, the vestibular nucleus, abducens nucleus, oculomotor nucleus, cerebellum, substantia nigra, nucleus reticularis tegmenti pontis, the thalamus, the deep layers of the superior colliculus and the oculomotor plant for each eye. Each of the neural sides in the model produce firing rates matching experimental data, and simulate fast eye movements that match the recorded data extremely well for saccades of all sizes. All features of these simulations, including peak velocity, duration, and amplitude conform to published observations. DTIC

N95-20307# Naval Aerospace Medical Research Lab., Pensacola, FL.
BEHAVIORAL EFFECTS OF TYROSINE DURING SUSTAINED WAKEFULNESS
D. L. WIEGMANN, D. F. NERI, R. R. STANNY, S. A. SHAPPELL, and A. H. MCCARDIE Dec. 1993 25 p
(Contract(s)/Grant(s): NR PROJ. MM3-3-P-30)
(AD-A279789; NAMRL-1392) Avail: CASI HC A03/MF A01

The fatigue and cognitive performance deficits associated with sleep loss and stress, like that experienced during sustained flight operations and nighttime flying, have motivated the search for effective nonpharmacological countermeasures. The behavioral effects of the potential countermeasure tyrosine, an amino-acid precursor to dopamine and norepinephrine, were examined during an episode of continuous nighttime work involving one night's sleep loss. Volunteers performed nine iterations of a battery of cognitive and subjective tasks for approximately 13 h, beginning at 1930 and ending at 0820 the following morning. Subjects remained awake throughout the day on which the experiment began and were awake for approximately 24 h by the end of testing. Six hours after the start of the experiment, one-half of the subjects received 150 mg/kg tyrosine in a split dose while the other half received a cornstarch placebo in a double-blind procedure. The tracking-task performance of tyrosine subjects declined less during the night than that of placebo subjects. Tyrosine administration was also associated with nonsignificant trends toward reducing: (1) lapses on a high-event-

rate vigilance task; (2) subjective sleepiness; and (3) the intensities of several fatigue-related symptoms. DTIC

N95-20408*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
METHOD AND APPARATUS FOR NON-INVASIVE EVALUATION OF DIAPHRAGMATIC FUNCTION Patent Application
WILLIAM T. YOST, inventor (to NASA), JULIETTE L. WAIT, inventor (to NASA) (Veterans Administration, Washington, DC.), PATRICIA A. NAHORMEK, inventor (to NASA) (Veterans Administration, Washington, DC.), JOHN H. CANTRELL, inventor (to NASA), and PAMELA D. HANNA-HAWVER, inventor (to NASA) (Analytical Services and Materials, Inc., Hampton, VA.) 14 Feb. 1994 21 p (NASA-CASE-LAR-13888-1; NAS 1.71:LAR-13888-1; US-PATENT-APPL-SN-195500) Avail: CASI HC A03/MF A01

A method for non-invasive evaluation of diaphragmatic function in humans measures the thickness of the diaphragm in real time with an ultrasonic device, and displays the variations of diaphragm thickness versus time. Formulae are given for calculating a quantitative value for the reserve fatigue capacity of a patient's diaphragm from data obtained by measuring the time limits for maintaining a constant breathing pattern on the display at two different pressure differentials in series with the patient's airways. An apparatus for displaying the diaphragm thickness in real time is also described. The method can be used both on healthy patients and on patients with so severe breathing dysfunctions that they require breathingsupport from respirators. Author

N95-20457 Biodynamic Research Corp., San Antonio, TX.
MODELING PLATFORM DYNAMICS AND PHYSIOLOGICAL RESPONSE TO SHORT ARM CENTRIFUGATION Final Report, 7 May - 17 Dec. 1993
DAVID J. PANCRATZ, JOHN B. BOMAR, JR., and JAMES H. RADDIN, JR. Mar. 1994 182 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(Contract(s)/Grant(s): F41624-93-C-6011)
(AD-A279640; AL/CF-TR-1994-0025) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

An analysis is presented for the operation of a short radius centrifuge on an orbiting platform. A review of literature confirms that such a centrifuge could be useful in ameliorating the effects of microgravity deconditioning of astronauts. Our analysis indicates that operation of the centrifuge could generate potentially destabilizing forces and moments. Several ideas for reducing or eliminating the forces and moments are discussed. The use of pedals to drive the centrifuge and exercise the rider is also described. Excess power from pedalling could be stored as electrical energy. A mathematical model of the human cardiovascular system indicates that centrifugation at a short radius would indeed stimulate the heart, even though there is a significant acceleration gradient from head to toe. Consideration of the disorienting effects of short radius centrifugation reveals that discomfort originating in the otoliths from the lack of gravity would probably be alleviated; however, the angular motion of the centrifuge would likely cause disorientation or discomfort through the semicircular canals. DTIC

N95-20485# Georgia Univ., Athens, GA. Dept. of Pharmacology and Toxicology.
INTERSPECIES EXTRAPOLATIONS OF HALOCARBON RESPIRATORY AND TISSUE KINETICS: APPLICATIONS TO PREDICTING TOXICITY IN DIFFERENT SPECIES Annual Report, 15 Jul. 1993 - 14 Jul. 1994
CHAM E. DALLAS, J. V. BRUCKNER, R. L. TACKET, and T. REIGLE 15 Aug. 1994 167 p
(Contract(s)/Grant(s): AF-AFOSR-0356-91)
(AD-A285055; AFOSR-94-0558TR) Avail: CASI HC A08/MF A02

A series of experiments have been conducted to provide a pharmacokinetic data base for interspecies comparisons and for formulation and validation of physiologically-based pharmacokinetic models. The basic experimental design has involved giving equal doses of halocarbons in different species, including mice, rats, and dogs. Perchloroethylene (PCE), tetrachloroethane (TET), trichloroethylene (TCE), and trichloroethane (TRI) have been employed as test chemicals, in order to evaluate the relative importance of the physicochemical property of volatility on the kinetics and toxicity of halocarbons. In order to determine the dose received in target organs and other tissues, serial samples of brain, liver, kidney, lung, heart, skeletal muscle, and adipose tissue have been taken and analyzed for halocarbon content after administration of PCE, TET, and TRI in rats, PCE and TET in dogs, and TRI in mice. For neurobehavioral studies, an operant testing system has been employed for monitoring the central nervous system effects of halocarbons. Neurobehavioral studies have been conducted following oral and inhalation exposure to PCE, and from inhalation exposure to TRI in rats. DTIC

N95-20549# California Univ., San Diego, La Jolla, CA.
SKELETAL MUSCLE ISCHEMIA AND HEAT SHOCK PROTEINS Annual Report, 1 Jul. 1993 - 30 Jun. 1994
WOLFGANG H. DILLMAN 26 Jul. 1994 9 p
(Contract(s)/Grant(s): DAMD17-93-J-3027)
(AD-A285364) Avail: CASI HC A02/MF A01

Blood loss resulting in decreased organ perfusion and subsequent ischemic injury of cardiac and skeletal muscle presents a significant problem for the soldier in combat. Recent findings have indicated that different forms of noxious stress including exposure to increased temperature, noxious chemical agents, and ischemia lead to increased expression of heat shock proteins (HSP) which have a protective effect against injury induced by noxious stimuli. We will determine in this proposal if a rat skeletal muscle derived permanent cell line, L6 cells, expressing increased amounts of HSP70 will show protection against damaged induced by simulated ischemia. To generate L6 cells which permanently overexpress the inducible HSP70 proteins, cells will be transfected with a neomycin resistance gene and the inducible HSP70 gene. Stable lines will be selected by growing L6 cells in the presence of neomycin. Cells which have the neomycin resistance gene and the HSP70 gene incorporated into their DNA will survive. Such stably transfected L6 cell lines will then be exposed to simulated ischemia consisting of hypoxia, absence of glucose, low tonicity, and resultant ischemic damage will be determined by quantitating cell viability measured in colony formation assays, the inhibition of protein synthesis and the release of cytoplasmic enzymes like creatine kinase. These studies will determine if inducible HSP70 exerts a protective effect against ischemia mediated muscle injury. Demonstrating a protective effect of HSP70 protein will make it a useful agent to reduce ischemic muscle damage in soldiers exposed to muscle injury in combat. DTIC

N95-20602 Defence Research Establishment Suffield, Ralston (Alberta).
ENHANCEMENT OF CELL MEDIATED IMMUNITY THROUGH NON-SPECIFIC IMMUNOSTIMULATION WITH LIPOSOME ENCAPSULATED GAMMA-INTERFERON
J. P. WONG, B. KOURNIKAKIS, E. G. SARAVOLAC, and L. C. GORTON Apr. 1994 24 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(AD-A279667; DRES-SR-584) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

The ability of liposome-encapsulated gamma interferon (LIP-gamma IFN) to stimulate mouse cell-mediated immunity was assessed both in vivo and in vitro. The enhancement of the cell-mediated immune response was demonstrated in vitro by a chemiluminescent assay which measured the phagocytic activity of peritoneal macrophages. Peritoneal macrophages harvested from mice treated with gamma interferon (gamma IFN) or muramyldipeptide showed significant increases in both macrophage yield as well as in ability to phagocytize zymosan particles. However, when treated with gamma IFN encapsulated within liposomes both macrophage yield and phagocytic activity further increased by at least 100% over unencapsulated gamma IFN. Using the in vivo influenza mouse protection model, intranasally administered LIP-gamma IFN resulted in a 70% survival rate to mice challenged intranasally with 10 LD50 doses of influenza A/PR/8 virus compared with a 20% survival rate with free gamma IFN. Together these results suggest that liposome encapsulation increases gamma

IFN efficacy in providing non-specific stimulation of the cell-mediated immune system. DTIC

N95-20710 Naval Aerospace Medical Research Lab., Pensacola, FL.
EFFECTS OF BIFOCAL AND PROGRESSIVE-ADDITION CORRECTIVE LENSES ON AVIATOR TARGET-DETECTION PERFORMANCE Interim Report, 1 Oct 1992 - 30 Sep. 1993
M. D. REDDIX, A. S. MARKOVITS, P. D. COLLYER, and S. R. OCONNELL Dec. 1993 17 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(Contract(s)/Grant(s): NR PROJ. M00-96)
(AD-A279698; NAMRL-1390) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

The objective of this project was to determine if the type of presbyopic correction worn by aviators, conventional bifocal versus progressive-addition lenses (PAL's), differentially affects aviator visual search performance. Experienced aviators with tactical fighter aircraft experience searched for high-contrast targets under simulated dawn/dust lighting conditions while wearing either a standard bifocal (ST-25) or PAL spectacle correction. Latency of locating high-contrast targets under these viewing conditions was affected differentially by the type of presbyopic correction used. Specifically, compared to a standard bifocal (ST-25), a PAL correction (Varilux Infinity) significantly lowered the time needed to locate static targets at a cockpit-instrument viewing distance (83 cm). Accuracy of target-location responses was not affected by the type of correction used. In addition, 7 months post experiment, 7 of the 12 participants (58%) indicated that they used their PAL correction exclusively when flying the T-39 Sabre Liner. Three subjects (25%) used their PAL correction intermittently (primarily at night) when flying, and two subjects preferred not to use the PAL's. These results suggest that: (1) relative to bifocals, speed of responding to static targets at intermediate viewing distances may be improved by wearing PALS; and (2) subjects were able to adapt to PAL lenses quickly in a laboratory setting, using them later in a functional aviation environment. DTIC

N95-20763*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ACOUSTIC CALIBRATION APPARATUS FOR CALIBRATING PLETHYSMOGRAPHIC ACOUSTIC PRESSURE SENSORS Patent Application
ALLAN J. ZUCKERWAR, inventor (to NASA) and DAVID C. DAVIS, inventor (to NASA) 11 May 1994 14 p
(NASA-CASE-LAR-14977-1; NAS 1.71:LAR-14977-1; US-PATENT-APPL-SN-243665) Avail: CASI HC A03/MF A01

An apparatus for calibrating an acoustic sensor is described. The apparatus includes a transmission material having an acoustic impedance approximately matching the acoustic impedance of the actual acoustic medium existing when the acoustic sensor is applied in actual in-service conditions. An elastic container holds the transmission material. A first sensor is coupled to the container at a first location on the container and a second sensor coupled to the container at a second location on the container, the second location being different from the first location. A sound producing device is coupled to the container and transmits acoustic signals inside the container. NASA

N95-20811# California Univ., Berkeley, CA. Dept. of Molecular Biology.
COMPUTER BASED ANALYSIS AND SYNTHESIS OF RETINAL FUNCTION Annual Report, 1 Feb. 1992 - 31 Jan. 1993
FRANK S. WERBLIN 27 Jan. 1994 16 p
(Contract(s)/Grant(s): AF-AFOSR-0196-91)
(AD-A286084; AFOSR-94-0676TR) Avail: CASI HC A03/MF A01

A fully functional, real time dynamic model of retinal activity has been implemented on a high speed digital image processor. The model uses a complete set of physiciological parameters derived from electrophysiological studies of synaptic transmission, cell coupling, voltage-gated currents and visual function in the retina of the tiger salamander. This model displays the patterns of activity generated at each sheet of retinal cells in real time, in response to any arbitrary stimulus pattern. Recent work measures both the patterns of activity and the activity of single units within the living retina itself at the level of the photoreceptors, horizontal and bipolar cells. These measurements are then correlated with the patterns generated by the model to verify the accuracy of the parameters and functions used to model the retina. For the most part, the correlations are quite close, suggesting that the parameters we have used and the functional relations between elements we have selected are adequate. A recording system using an array of electrodes to constructed and will be used during the next year to record patterns of activity. These patterns will then be compared with those generated by the model. DTIC

N95-20848# Texas Univ. Health Science Center, San Antonio, TX.
INVESTIGATION OF LASER-INDUCED RETINAL DAMAGE: WAVELENGTH AND PULSEWIDTH DEPENDENT MECHANISMS Final Technical Report, 1 Apr. 1992 - 30 Jun. 1994
RANDOLPH D. GLICKMAN 30 Jun. 1994 19 p
(Contract(s)/Grant(s): AF-AFOSR-0208-91)
(AD-A286066; UTHSCSA-OPH-94-01; AFOSR-94-0621TR) Avail: CASI HC A03/MF A01

Although the consequences of excessive light exposure to the eye have been known since ancient times, the actual mechanisms of light damage in biological tissue have only been systematically investigated in this century. The response of tissue to laser or incoherent light depends on the power density, peak power, and wavelength of irradiating energy. At least three light damage mechanisms have been identified. Photochemical damage is produced by short wavelength light (typically less than 550 nm) of long exposure duration, low peak power, and relatively low to moderate power density. Because tissue heating is minimal under these conditions, damage is thought to occur as result of excitation of target molecules to excited triplet states, some of which damage tissues directly through proton or electron transfers. The light-activated molecules may also cause damage indirectly by reacting with molecular oxygen to produce oxygen radicals, which are known agents of cellular damage. Thermal damage may be produced by light exposures of any wavelength capable of being absorbed by the tissue, given a sufficiently high power density and/or moderate to high peak power. Heating occurs by direct absorption of photons by a tissue chromophore which converts this photic energy into increased vibrational modes. The target chromophore, as well as surrounding structures depending on local heat conductivity, may then undergo thermal denaturation. At very high peak power, however, the strength of E-, or electrical, field of the absorbed electromagnetic wave may exceed the dielectric properties of the absorbing tissue, causing optical breakdown, ionization, plasma formation, and other phenomena associated with nonlinear (photodisruptive) damage mechanisms. DTIC

N95-20850# East Carolina Univ., Greenville, NC. School of Medicine.
EVALUATION OF DRIED STORAGE OF PLATELETS FOR TRANSFUSION: PHYSIOLOGIC INTEGRITY AND HEMOSTATIC FUNCTIONALITY Triannual Report No. 2, 1 Jun. - 30 Sep. 1994
ARTHUR P. BODE 27 Oct. 1994 7 p
(Contract(s)/Grant(s): N00014-92-J-1244)
(AD-A286078) Avail: CASI HC A02/MF A01

The current long term dried storage study was terminated at 8 months in this reporting period. The preparations under study were (1) 0.02% permanganate in 5% BSA, and (2) 1.8% paraformaldehyde in 500 mM Trehalose stored desiccated at RT, 4 C, or at -70 C. Neither prep maintained good morphology at any temperature, and there was minimal ristocetin aggregation or hypotonic shock response remaining. At this 8 month workup, yield of intact platelets upon reconstitution was dependent on the storage conditions: 27-29% for RT, 41-46% for 4 C, 68-78% for -70 C. Our conclusion from this study reinforces what we learned from earlier storage studies: that there is significant deterioration of product at RT. In this particular experiment we found that

permanganate-treated platelets, or para-platelets dried in Trehalose are as susceptible to loss of integrity over time as other preps. Our platelet handling techniques have improved since these studies were initiated. Another set of new preparations will be set aside for long-term storage in the next reporting period. DTIC

N95-20851# East Carolina Univ., Greenville, NC. School of Medicine.
PRECLINICAL INVESTIGATION OF LYOPHILIZED PLATELET PREPARATIONS Annual Report No. 1, 1 Sep. - 31 Aug. 1994
ARTHUR P. BODE 31 Oct. 1994 9 p
(Contract(s)/Grant(s): N00014-93-J-1034)
(AD-A286079) Avail: CASI HC A02/MF A01

We have previously shown that lyophilized platelets (L-Plt) retain properties of adhesion and activatability in the Baumgartner perfusion chamber (Trans 33:72S, 1993). Now we have analyzed L-Plt in two systems directly testing hemostatic function. Study Design: One is a prototype device simulating the Ivy bleeding time in vitro (IVBT) and collagen-induced thrombus formation (CITF) in recalcified whole blood (Xylum Clot Signature Analyzer: CSA); the other is an in vivo bleeding time in dogs on full clinical heart-lung bypass before and after infusion of L-Plt. Results: On the CSA, L-Plt gave an average (n=4) IVBT of 1 min 58 sec and a CITF of 73% versus 2 min 14 sec and 88% respectively for fresh platelets. Expired platelet concentrates gave indeterminate results because aggregates clogged the lines. IVBT greater than 6 min and CITF less than 25% is typical of vWD patients. In two canine heart-lung bypass studies, the in vivo bleeding time improved from greater than 15 min to 5-7 min after infusion of abolus of 2-3 x 1011 L-Plt. The corrected count increments were (1) 88% and (2) 47% based on estimated circulatory volume. Conclusions: These results demonstrate the hemostatic activity of L-Plt and their potential value in transfusion medicine. DTIC

N95-20971# Helsinki Univ. of Technology, Espoo (Finland). Dept. of Technical Physics.
SEMINAR ON BIOMEDICAL ENGINEERING 1993
T. KATILA, ed. and JYRKI LOTJONEN, ed. 23 Mar. 1994 123 p Seminar held in Feb. - Apr. 1993 (ISSN 0355-7804)
(PB95-104402; TKK-F-B151; ISBN-951-22-1612-4) Avail: CASI HC A06/MF A02

Devices that collect 3D data from human beings are nowadays very common diagnostic tools in big hospitals. Magnetic Resonance Imaging (MRI) and Computerized Tomography Imaging (CT) produce very detailed anatomical information of a human being. Those methods collect a series of 2D images. When slices are put one on the other, a 3D image can be created. The finest resolution of modern imaging devices is about one millimeter (MRI and CT techniques). Usually the interslice distance is longer than the pixel distance in the slices. The resolution limits the size of the collected digital images. This problem can be removed by enlarging the image. Because data is in digital form we have to calculate more voxels (3D pixel) between the original points. This is called interpolation. NTIS

N95-20977 Naval Aerospace Medical Research Lab., Pensacola, FL.
BIBLIOGRAPHY OF SCIENTIFIC PUBLICATIONS 1975-1993
K. S. MAYER Mar. 1994 61 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(AD-A279767) Avail: CASI HC A04

This publication lists citations of all unclassified research reports, special reports, monographs, joint reports, journal articles, and proceedings that were published by the Naval Aerospace Medical Laboratory during calendar years 1975 through 1993. Qualified users may request reprints from the Defense Technical Information Center, Cameron Station, Alexandria, VA 22314 (commercial 202/274-7633 or DSN 284-7633). Reports are available to the public from the National Technical Information Service, Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161 (telephone 703/487-4650). DTIC

N95-20979# Environmental Protection Agency, Research Triangle Park, NC. Clinical Research Branch.
CARBOXYHEMOGLOBIN FORMATION DUE TO TRANSIENT EXPOSURE TO HIGH LEVEL CARBON MONOXIDE: EXPERIMENTAL RESULTS AND AN EXPLANATORY MODEL Final Report, 18 Aug. 1987 - 30 Sep. 1994
MILAN J. HAZUCHA (North Carolina Univ., Chapel Hill, NC.), MARJOLEIN V. SMITH (Smith, Marjolein V., Raleigh, NC.), VERNON A. BENIGNUS, and PHILLIP A. BROMBERG (North Carolina Univ., Chapel Hill, NC.) Sep. 1994 68 p
(AD-A285476) Avail: CASI HC A04/MF A01

Fifteen men were exposed to 6,683 PPM C180 for 3.1 - 6.6 min. Venous and arterial blood sample were drawn at one-min intervals beginning at the start of exposure and finishing 10 min later. Simultaneously, V(sub A) was calculated from the measured values of V(sub E) and deadspace. V(sub E) was measured by integrating digitized continuous measures of inhaled and exhaled gas. All parameters of the nonlinear Coburn-Forster-Kane equation (CFKE) were measured on the individual subject except for the Haldane affinity ratio. Predictions of venous blood COHb in samples collected ca. two min after cessation of exposure were accurately predicted by the CFKE. Both venous and arterial COHb were inaccurately predicted during COHb formation, however. Venous levels were overpredicted during formation due to delayed appearance of COHb. Individual subjects differed markedly in the delay of COHb appearance in venous blood. Arterial COHB was consistently underestimated either by the CFKE or by predictions based on venous blood samples. Thus, exposure of such organs as brain or heart to COHb can be higher than expected from previous knowledge when transient CO exposure is involved. An explanation is suggested for the observed differences between arterial and venous COHb on the basis of the regional circulation of the forearm, where both samples were taken. Because regional circulation patterns are known to vary with physical training, the differences in physical training between subjects may account for the observed variation. An expanded model was derived from the Coburn-Forster-Kane equation that reflects the above hypothesis. Most of the parameter values for the expanded model were measured on individual subjects. Literature values were used for other parameters. DTIC

N95-21007 Technical Research Centre of Finland, Espoo (Finland).
ANALYSIS OF MUSCULO-SKELETAL LOADING USING ELECTROMYOGRAPHY AND BIOMECHANICAL MODELLING Ph.D. Thesis
HANNU NIEMINEN 1 Jun. 1994 257 p
(PB95-135828; VTT/PUB-180) Copyright Avail: Issuing Activity (National Technical Information Service (NTIS))

Musculoskeletal disorders of chronic nature are a serious problem in modern society. Two important methods for studying the operation of the musculoskeletal system and indirectly estimating the muscle forces are biomechanical modelling and electromyography (EMG). NTIS

N95-21016 Technische Univ., Delft (Netherlands).
RADIOFREQUENCY HYPERTHERMIA SYSTEMS: EXPERIMENTAL AND CLINICAL ASSESSMENT OF THE FEASIBILITY OF RADIOFREQUENCY HYPERTHERMIA SYSTEMS FOR LOCO-REGIONAL DEEP HEATING Ph.D. Thesis
G. C. VANRHOON 1994 205 p Prepared in cooperation with Daniel den Hoed Cancer Center, Rotterdam, Netherlands
(PB94-206885; ISBN-90-6275-978-5) Copyright Avail: Issuing Activity (National Technical Information Service (NTIS))

Contents are: introduction; loco-regional deep hyperthermia; methods to evaluate the characteristics of hyperthermia applicators; the RCA 27 MHz ridged waveguide system; the HTM3000P capacitive hyperthermia system; a ring applicator system for loco-regional

deep hyperthermia; and experimental assessment of electric impedance tomography integrated with the ring applicator. NTIS

N95-21028 Technische Hogeschool, Delft (Netherlands).
INTEGRATION OF SEGMENTATION AND STEREO MATCHING Ph.D. Thesis
Y. ZHANG 16 Jun. 1994 187 p
(PB95-107819; ISBN-90-9007256-X) Copyright Avail: Issuing Activity (National Technical Information Service (NTIS))

Segmentation and stereo matching are the two essential steps in stereo vision. The thesis deals with their integration and can be roughly divided into three parts: segmentation, local matching, and global matching. It uses the Minimal Description Length (MDL) principle to encode image intensities and introduce a robust method to estimate the image intensity from raw image data. It also develops an approach for shape constrained image segmentation which integrates region growing and region boundary fitting. The thesis then deals with local matching in which only the local attributes of image regions are considered. It contains a detailed discussion on the integration of segmentation and stereo matching. The introduction of feedback enables the proposed system to send back the matching result to a resegmentation stage to improve the segmentation result and consequently the matching result. It then moves on to discuss global matching whose goal is to get unique matches, taking care of topological and other matching constraints. It formulates the global matching as a relaxation problem. NTIS

N95-21160# Naval Health Research Center, San Diego, CA.
MICROCLIMATE COOLING EFFECT ON PERCEIVED EXERTION IN FOUR HEAT/EXERCISE SCENARIOS Interim Report
RALPH G. BURR, DANIEL W. TRONE, ROBERT S. POZOS, ELMER J. LABRANCH, and CHRISTOPHER S. PARRISH May 1994 16 p
(Contract(s)/Grant(s): NR PROJ. MM3-3-P-30)
(AD-A285549; NHRC-94-7) Avail: CASI HC A03/MF A01

Operation Desert Storm demonstrated a need for individual microclimate cooling during strenuous activity. Evaluation of a cooling system should not only consider physiological functions but subjective measures of comfort, such as ratings of perceived exertion (RPE). The objectives of this study were evaluate a cooling suit's effect on: (1) subjective RPE, (2) heart rate (HR), and (3) the magnitude of the correlation between RPE and HR. Thirty-one U.S. Marine Corps subjects, wearing chemical defense ensemble, were tested in four separate scenarios of heat/exercise combinations during both cooling suit and control sessions. Results of repeated measures multivariate analysis of variance showed that RPE was significantly lowered by wearing a cooling suit during only the most strenuous of the four scenarios. A decrease in the magnitude of the correlation between RPE and HR during all four cooling suit sessions indicated that a microclimate cooling suit interferred with perception of exertion. DTIC

N95-21180 Naval Aerospace Medical Research Lab., Pensacola, FL.
THE SHARPER IMAGE: IMPLEMENTING A FAST FOURIER TRANSFORM (FFT) TO ENHANCE A VIDEO-CAPTURED IMAGE Special Report
J. E. PARKER, W. K. KREBS, J. S. MARSH, D. L. STILL, and L. A. TEEME Jan. 1994 35 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(Contract(s)/Grant(s): NR PROJ. MM3-3130)
(AD-A279790; NAMRL-SR-94-1) Avail: CASI HC A03

The lack of visual information and cues in night vision images has produced a history of in-flight mishaps where night vision devices (NVDS) were used as the primary source of sight. In an effort to produce improved night vision images and thereby reduce in-flight mishaps, a video enhancement technique, the sharper image, was developed to enhance, filter, and study images generated by NVDS. The sharper image technique enhances night vision images by filtering or amplifying the spatial frequencies that are distorted by NVDS. In this report, we describe the necessary methodology and procedures to enhance, filter, or process any visual image. We also discuss other computational image software and review the advantages and disadvantages of each. DTIC

N95-21348# Helsinki Univ. of Technology, Espoo (Finland). Low Temperature Lab.
SOURCE DISTRIBUTION OF VISUAL EVOKED NEUROMAGNETIC RESPONSES
SEPPO AHLFORS, RISTO J. ILMONIEMI (Helsinki Univ. Central Hospital, Helsinki, Finland.), MATTI KAJOLA, JUKKA KNUUTILA, and JUHA SIMOLA May 1994 18 p See also PB85-201036
(ISSN 0355-7790)
(PB95-127643; TKK-F-A729) Avail: CASI HC A03/MF A01

Visual contrast-onset-evoked magnetic fields were measured with a 122-channel magnetometer covering the whole scalp. To facilitate the estimation of the spatial and temporal distribution of cortical generators, the responses were broken into two parts according to the dependence on the visual-field location of the stimulus. Minimum-norm estimates suggested that the generators for the part that was independent of the stimulus position were located in several occipital and extra-occipital regions, whereas the visual-field-dependent generators were predominantly in the occipital cortex. Our results support the view that information about the retinal image, even during passive viewing, is routed to several cortical areas. NTIS

N95-21352# Netherlands Inst. for Brain Research, Amsterdam (Netherlands).
NETHERLANDS INSTITUTE FOR BRAIN RESEARCH PROGRESS REPORT, 1993
R. M. BUIJS, O. PACH, and W. T. P. VERWEIJ 1994 117 p
(PB95-135398) Avail: CASI HC A06/MF A02

The central research theme of the Netherlands Institute for Brain Research is 'Development, plasticity and aging of the brain'. The theme has been specified in the following three themes and four research programs. Hypothalamus 1-Life span functions of hypothalamic nuclei in health and disease; Hypothalamus 2-Hypothalamic integration mechanisms; The development and plasticity of the prefrontal cortex (PFC); Significance of structure-function relationships for the development and self-organization of neurons and networks. NTIS

N95-21424 Centre d'Etudes et de Recherches de Medecine Aeronautique, Paris (France). Dept. de Physiologie Analytique.
EFFECT OF INCREASED VENOUS BACKFLOW ON THE RELEASE OF CARDIAC HORMONE. FINE STRUCTURAL, IMMUNOHISTOCHEMICAL, AND BIOCHEMICAL STUDY Final Report [EFFETS DE L'AUGMENTATION DU RETOUR VEINEUX SUR LA LIBERATION DE L'HORMONE CARDIAQUE. ETUDE ULTRASTURCTURALE, IMMUNOHISTOCHIMIQUE ET BIOCHIMIQUE]
X. HOLY, E. ZERATH, P. FACY, A. FRANCOIS, and A. MALOUVIER Feb. 1993 100 p In FRENCH Sponsored by Direction des Recherches, Etudes et Techniques
(PB95-130399) Avail: Issuing Activity (National Technical Information Service (NTIS))

This study sought to identify the cellular events that occur after a blood shift to the upper part of the body stimulates the release of Atrial Natriuretic Factor (ANF). Eight male rats were placed in antiorthostatic position (-30 deg) to produce right atrial distention for periods ranging from 1/4 hour to 6 hours. Samples of the right atrial appendage were then analyzed. Results showed a significant increase in immunoreactivity inside the granules after 1/2 hour of stimulation. The number of granules rose, but the size of the vesicles did not change. Plasma ANF concentration increased significantly after 1 hour of stimulation. This result indicates that in less than 1/2 hour, heart myocytes can modify their storage of ANF, and that the concentration of the hormone inside secretion vesicles increases at an early stage. The delay between this event and the hormone's peak plasma level is probably linked to the vesicles' release process. Further studies are need to describe the mechanism involved. NTIS

N95-21580 Technische Hogeschool, Delft (Netherlands). Dept. of Mechanical Engineering and Marine Technology.
INTRAMYOCARDIAL BLOOD VOLUME AND OXYGEN EXCHANGE Ph.D. Thesis
C. P. B. VANDERPLOEG 7 Jun. 1994 142 p
(PB95-108015; ISBN-90-370-0104-1) Copyright Avail: Issuing Activity (National Technical Information Service (NTIS))

Contents include the following: Introduction; Functional Distribution of Coronary Vascular Volume in the Beating Goat Heart; Comparison of Different Oxygen Exchange Models; Heart Rate Influences Gregg's Phenomenon During Flow Controlled Perfusion in Goats; Transients in Myocardial Oxygen Consumption Following Abrupt Changes in Perfusion Pressure in the Goat; Effect of Heart Contraction on the Functional Distribution of Coronary Volume in Goats; and Conclusions. NTIS

N95-21595# Michigan Univ., Ann Arbor, MI.
RADIOPHARMACEUTICALS FOR DIAGNOSIS Progress Report, 1987-1993
Mar. 1994 51 p
(Contract(s)/Grant(s): DE-FG02-88ER-60639)
(DE95-002200; DOE/ER-60639/6) Avail: CASI HC A04/MF A01

In the period 1969-1986, this project was directed to the evolution of target-specific labeled chemicals useful for nuclear medical imaging, especially radioactive indicators suited to tracing adrenal functions and localizing tumors in the neuroendocrine system. Since 1986, this project research has focused on the chemistry of positron emission tomography (PET) ligands. This project has involved the evaluation of methods for radiochemical syntheses with fluorine-18, as well as the development and preliminary evaluation of new radiopharmaceuticals for positron emission tomography. In the radiochemistry area, the ability to predict fluorine-18 labeling yields for aromatic substitution reactions through the use of carbon-13 NMR analysis was studied. Radiochemical yields can be predicted for some structurally analogous aromatic compounds, but this correlation could not be generally applied to aromatic substrates for this reaction, particularly with changes in ring substituents or leaving groups. Importantly, certain aryl ring substituents, particularly methyl groups, appeared to have a negative effect on fluorination reactions. These observations are important in the future design of syntheses of complicated organic radiopharmaceuticals. In the radiopharmaceutical area, this project has supported the development of a new class of radiopharmaceuticals based on the monoamine vesicular uptake systems. The new radioligands, based on the tetrabenazine structure, offer a new approach to the quantification of monoaminergic neurons in the brain. Preliminary primate imaging studies support further development of these radioligands for PET studies in humans. If successful, such radiopharmaceuticals will find application in studies of the causes and treatment of neurodegenerative disorders such as Parkinson's disease. DOE

N95-21629 Science Applications International Corp., McLean, VA.
ACUTE RADIATION SICKNESS AMELIORATION ANALYSIS Technical Report, 20 Jul. 1990 - 19 Jul. 1993
SABINA I. ROBINSON, ALAN J. FEISTER, and DONNA L. BAREIS 1 May 1994 91 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(Contract(s)/Grant(s): DNA001-90-C-0111)
(AD-A279084; DNA-TR-93-131) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

Three tasks were conducted under the acute radiation sickness amelioration analysis in support of the Defense Nuclear Agency (DNA) and NATO Army Armaments Group (NAAG) Project Group 29 (PG-29) on drugs for the prevention of radiation-induced nausea and vomiting: (1) documents were collected and entered into a data base, (2) data reviews and analyses were performed, and (3) PG-29 and Triservice meetings involving anti-emetic drug development were supported and documented. Approximately 2000 documents were collected, with 1424 complete bibliographic citations entered into a WordPerfect 5.1 data base. Eight reviews and analyses addressing different aspects of the safety and efficacy of the candidate anti-emetic drugs ondansetron and granistron were prepared. Support was provided for seven international PG-29 meetings and two U.S. Triservice meetings in which the efforts of PG-29 were discussed. These tasks have enabled the DNA and PG-29 to make good progress toward the goal of recommending a serotonin type-3 (5-HT3) receptor antagonist anti-emetic drug for use in military personnel. DTIC

N95-21941 Rothe Development, Inc., San Antonio, TX.
THE INFLUENCE OF CORONARY ARTERY DISEASE ON +GZ TOLERANCE: A PRELIMINARY STUDY Final Report, Feb. 1989 - Dec. 1991
JOHN W. BURNS, JEMETT L. ROBINSON, JOHN W. FANTON, HAROLD DAVIS, and LONDE A. RICHARDSON Apr. 1994 7 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(Contract(s)/Grant(s): F33615-85-D-4510; AF PROJ. 7930)
(AD-A279305; AL/CF-TP-1994-0004) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

Current Air Force policy restricts pilots, with even minimal coronary artery disease (CAD), from flying high-performance aircraft. Liberalization of this policy is being considered, but additional data are needed for more informed decision. Eleven miniature swine (MS) were placed on a high cholesterol/high fat diet for 1 year. Five additional MS were maintained on a standard control swine diet (no cholesterol) over the same time. A vascular access port (VAP) was surgically placed into the superior vena cava. The 16 unanesthetized MS were +Gz-stressed one or two times each, using an alternating 4-8 +Gz simulated aerial combat maneuver (SACM) with 10 sec at each +Gz level. The MS were protected with an abdominal bladder anti-G suit. At the end of the SACM, Tc-99m was infused into the VAP and the MS were scanned for myocardial perfusion approximately 1 h later. Three MS died before data collection, one at 6 mos and two at 9 mos. Histopathology showed moderate-to-severe CAD in the three MS. Control and experimental plasma cholesterol levels (mg%) were: total = 77 and 422; ratio = 2.3 and 8.6; LDL = 35 and 353, respectively. Dysrhythmias and T-wave alterations during +Gz were seen equally in both the control and experimental MS. However, ST-T segment changes during +Gz were observed in all of the cholesterol MS, but not in the control MS. DTIC

N95-21947* National Aeronautics and Space Administration, Washington, DC.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 399)
Mar. 1995 121 p
(NASA-SP-7011(399); NAS 1.21:7011(399)) Avail: CASE HC A06

This bibliography lists 299 reports, articles and other doc-uments introduced into the NASA Scientific and Technical Infor-mation System during March 1995. Subject coverage includes: aerospace medicine and physiology, life support systems and man/system technology, protective clothing, exobiology and extrater-restrial life, planetary biology, and flight crew behavior and per-formance. Author

N95-21989# Naval Aerospace Medical Research Lab., Pensacola, FL.
COMMAND HISTORY, 1993 Final Report, Jan. - Dec. 1993
R. E. GADOLIN and K. S. MAYER Apr. 1994 145 p
(AD-A279775) Avail: CASI HC A07/MF A02

This publication is a compilation of significant events that occurred at the Naval Aerospace Medical Research Laboratory during 1993. DTIC

N95-22001 Defence and Civil Inst. of Environmental Medicine, Downsview (Ontario).
THERMAL RESISTANCE OF THE CHEEK IN COLD AIR
R. J. OSCZEVSKI Sep. 1994 9 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(AD-A286257; DCIEM-94-47) Avail: CASI HC A02

Some experiments were carried out to characterize the thermal

resistance of the tissues of the cheek area. Heat flow and skin temperature in cold air were measured with a heat-flux transducer. The face was cold when the cheek skin temperature was below 15 C and painful when the skin temperature fell below 10 C. Thermal resistance increased as skin temperature fell, reaching a maximum of 0.07 m(exp 2) K/W at a skin temperature between 10 C and 15 C. DTIC

N95-22003# Naval Medical Research Inst., Bethesda, MD.
SOLUBILITIES OF NITROGEN AND HELIUM IN WATER AND BLOOD AT 37 C AND PRESSURES OF UP TO 11 ATA Technical Report, 1990 - 1992
J. THAI and G. ALBIN Jun. 1994 17 p
(Contract(s)/Grant(s): PROJ. M00-99)
(AD-A286269; NMRI-94-21) Avail: CASI HC A03/MF A01

The solubilities of N2 and He in water and whole blood were measured at 37 C using a barometric method described in an earlier report. Solubilities have been measured successfully in H2O at approximately 2 ATA and approximately 11 ATA. In addition, protocols for measuring solubilities in whole blood have been explored. Measurements in blood have been unsuccessful thus far (i.e., have disagreed with published results), apparently because efforts have failed to eliminate interphase transport of the metabolic gases O2 and CO2 during the experiment. Blood experiments can resume after the experimental assembly has been modified to allow sampling of the gas phase so that its composition can be determined. This information, in conjunction with the pressure measurements that already are made during each experiment, will enable one to eliminate the confounding effect of O2 and CO2 transport. DTIC

N95-22004# Army Research Inst. of Environmental Medicine, Natick, MA.
SUSTAINING THE HEALTH AND PERFORMANCE OF SOLDIERS/WARFIGHTERS DEPLOYED TO HARSH ENVIRONMENTS Final Technical Note
BEAU J. FREUND, G. C. LINDSAY, and ROSS E. LIPTON Nov. 1994 27 p
(AD-A286270; USARIEM-TN95-2) Avail: CASI HC A03/MF A01

This report describes the contributions, core competencies, and capabilities of the U.S. Army Research Institute of Environmental Medicine and this institute's commitment to protect, sustain, and enhance the health and performance of soldiers. The institute's mission focuses on two of the four major threats to the warfighter: environmental and occupational. The significance placed upon environmental threats is described in Army FM 100-5, '... U.S. Army forces must be prepared to fight and win on short notice anywhere in the world, from blistering deserts, frigid wastelands, in rain forests, tundra, mountains, jungles and swamps ... ' Environmental threats to the soldier are addressed with militarily relevant discussions of injuries and casualties incurred by military forces operating in harsh environments within the research disciplines of environmental physiology and medicine. Occupational threats are presented in areas of physical capabilities, physical and cognitive performance, and the multi-stressors associated with continuous and sustained operations. The impact of these threats is studied within the research disciplines of occupational physiology and physical performance; occupational medicine; military performance and neuroscience; and military nutrition. The products of this research institute draw heavily upon the knowledge gained by its research staff over the past forty years and by our researchers that have accompanied troops deployed around the world in training, peacekeeping, and combat operations. DTIC

N95-22027# Hilton Systems, Inc., Cherry Hill, NJ.
AGE 60 STUDY. PART 1: BIBLIOGRAPHIC DATABASE Final Report
Oct. 1994 181 p
(Contract(s)/Grant(s): DTFA02-90-C-90125)
(AD-A286245; DOT/FAA/AM-RN-94/20-PT-1) Avail: CASI HC A09/MF A02

As part of their research contract with the FAA to study issues related to the Age 60 Rule for pilot mandatory retirement, Hilton Systems, Inc. in collaboration with Lehigh University faculty and research facilities, compiled this extensive bibliography. Topics included pilot aging, performance, health and physiological factors, as well as other aviation and pilot related topics. Citations were included from a variety of sources including international and military studies. The bibliography was organized in three sections. The first section presents a bibliographic listing on the above topics. The second section provides a listing of publications by authors active in related fields. Finally, the third section provides citations from the driving literature. DTIC

N95-22040# Hilton Systems, Inc., Cherry Hill, NJ.
AGE 60 STUDY. PART 2: AIRLINE PILOT AGE AND PERFORMANCE. A REVIEW OF THE SCIENTIFIC LITERATURE Final Report
DIANE T. HYLAND, EDWIN J. KAY, JIM D. DEIMLER, and ERNEST B. GURMAN Oct. 1994 139 p
(Contract(s)/Grant(s): DTFA02-90-C-90125)
(AD-A286246; RN-8025-1A-PT-2; DOT/FAA/AM-94/21-PT-2) Avail: CASI HC A07/MF A02

This review of the literature establishes the scientific foundation for subsequent studies on the Age 60 Rule research conducted under a contract with Hilton Systems, Inc. The scientific literature relevant to the separate scientific approaches required by the contract is reviewed. The document first provides a review of the Age 60 Rule, as well as theoretical and methodological considerations critical to the study of aging and the assessment of individual pilot performance. A proposed model is presented to form a framework for the research. Pilot behaviors affected by aging and/or experience are reviewed. Specific performance assessment batteries are reviewed in detail in Appendix A. Issues related to measuring complex pilot performance are discussed. Recommendations and criteria for developing a performance methodology are presented. The second part of the literature review provides a discussion of the issues related to the analysis of existing data to assess the relationship between pilot age, experience, and accident rates. This section provides a critical review of existing analyses and presents recommendations for an improved analytical methodology. DTIC

N95-22083 Gezondheidsraad, Hague (Netherlands).
OPTICAL RADIATION: HEALTH BASED EXPOSURE LIMITS FOR ELECTROMAGNETIC RADIATION IN THE WAVELENGTH RANGE FROM 100 NANOMETER TO 1 MILLIMETER [OPTISCHE STRALING: GEZONDHEIDSKUNDIGE ADVIESWAARDEN VOOR BLOOTSTELLING AAN ELEKTROMAGNETISCHE STRALING MET GOLFLENGTEN TUSSEN 100 NANOMETER EN 1 MILLIMETER]
29 Jun. 1993 134 p In DUTCH
(PB95-132767) Avail: Issuing Activity (National Technical Information Service (NTIS))

Optical radiation includes infrared radiation, light and ultraviolet radiation. It is a form of electromagnetic radiation with wavelengths between 1 millimeter and 100 nanometers. The main source of optical radiation is the sun. Examples of artificial sources of optical radiation are electric radiators, halogen heaters and lamps, light bulbs, gas discharge tubes and various types of lasers. Excessive exposure to optical radiation can damage health. The levels at which this happens and the effects that occur are the subject of this report. Possible health-promoting effects of optical radiation are not considered. NTIS

N95-22285# Inhalation Toxicology Research Inst., Albuquerque, NM.
URBAN AIR CARCINOGENS AND THEIR EFFECTS ON HEALTH
JOHN F. LECHNER 1994 13 p Presented at the Health and Environment Meeting, Mexico City, Mexico, 20-21 Oct. 1994
(Contract(s)/Grant(s): DE-AC04-76EV-01013)
(DE95-002259; CONF-9410236-2) Avail: CASI HC A03/MF A01

Airborne carcinogens may be relevant especially in metropoli-

tan regions with extreme smog as a primary cause of lung cancer. Lung cancer is most common in urban environs and the incidence directly correlates with the size of the city. In addition, several, but not all formal epidemiological studies also suggest a positive correlation between lung cancer incidence and the intensity of air pollution exposure. There is further support for a role of air pollution; as of 1993, 4.4% of all of the bronchogenic adenocarcinoma cancer cases among Mexicans living in industrialized cities are under 40 years of age. It is plausible that chronic inhalation of automobile combustion products, factory emissions, and/or radon is at least partially responsible for the higher incidence of lung cancer exemplified by the never-smoking urban residents. The exceptionally high incidence of lung cancer cases among never-smokers living in highly industrialized Mexican cities offers a unique opportunity to use molecular epidemiology to test whether chronic inhalation of atmospheric pollutants increases the risk for this disease. Overall, the analysis of the genetic alterations in two cancer genes, and possibly the hprt locus should give new insight as to whether the urban never-smokers developed their cancers because of exposure to environmental pollutants. DOE

N95-22287# Inhalation Toxicology Research Inst., Albuquerque, NM.

CURRENT CONCEPTS ON AIRBORNE PARTICLES AND HEALTH

JOE L. MAUDERLY 1994 15 p Presented at the Health and Environment Meeting, Mexico City, Mexico, 20-21 Oct. 1994
(Contract(s)/Grant(s): DE-AC04-76EV-01013)
(DE95-002260; CONF-9410236-1) Avail: CASI HC A03/MF A01

Epidemiological evidence of associations between environmental particulate concentrations and both acute and chronic health effects has grown with numerous recent studies conducted in the US and other countries. An association between short-term changes in particulate levels and acute mortality now seems certain. The association is consistent among studies and coherent among indicators of mortality and morbidity. Effects observed at surprisingly low pollution levels have raised concern for current exposures even in modestly polluted cities. Toxicology did not predict the acute mortality effect, and causal mechanisms are difficult to rationalize. Present data suggest that the fine fraction of particulate pollution is more toxic than larger particles, but the contribution of specific particulate species is poorly understood. DOE

N95-22361 Centre de Recherches du Service de Sante des Armees, La Tronche (France).

STUDY OF PULSED LASER EFFECTS ON LIVING TISSUES Final Report [ETUDE DES EFFETS LASERS PULSES SUR LES TISSUS VIVANTS]

L. COURT, D. COURANT, D. DORMONT, and B. ABADIE 1994 59 p In FRENCH Prepared in cooperation with Direction des Recherches, Etudes et Techniques, Paris, France
(PB95-131330) Avail: Issuing Activity (National Technical Information Service (NTIS))

The object of the research was to study the effects of brief laser pulses emitted in the visible spectrum and the near infrared on living tissues, the eye and cell cultures, and human fibroblasts. Within the limits of their experimental conditions, the authors found that the irradiation of human fibroblasts by a laser beam will not alter the range of oncogenes that are normally expressed, their level of expression, and their regulation according to their growth. Because of technical problems, the study of the Ha-ras oncogene will require a more detailed analysis of the messenger RNA of the irradiated cells. NTIS

N95-22371# Helsinki Univ. of Technology, Espoo (Finland).

TRANSFORMATION OF MULTICHANNEL MAGNETOCARDIOGRAPHIC SIGNALS TO STANDARD GRID FORM

J. NUMMINEN, S. AHLFORS, R. J. ILMONIEMI, J. MONTONEN, and J. NENONEN Apr. 1994 33 p
(PB95-127114; TKK-F-A727) Avail: CASI HC A03/MF A01

Multichannel magnetocardiographic (MCG) recordings with fixed sensor arrays are not directly comparable with single-channel measurements carried out at standard grid locations. In addition, comparison of data obtained with different types of magnetometers is difficult. The authors present a method for transforming multichannel measurements to the standard-grid format. The minimum-norm estimate (MNE) of the source current distribution in the body is calculated, and the desired field components in standard grid points are then computed from the MNE. The authors measured three subjects with both a 24-channel and a single-channel instrument. The signals extrapolated from the multichannel measurements corresponded quite well to the single-channel data registered at the standard grid locations, especially in those grid points that were covered by the 24-channel device. It was also found that the method is relatively tolerant to errors in the location and orientation of the multichannel magnetometer. The basic advantage of the authors extrapolation method is its physiologic nature: the method is based on the mathematical modeling of the source current distribution rather than on direct constraints applied to the magnetic field. NTIS

N95-22475# Columbia Univ., New York, NY.

DIFFUSIBLE DRIVING AND COUPLING SIGNALS OF THE BIOLOGICAL CLOCK Final Report, 1 Apr. 1992 - 31 Mar. 1994

RAE SILVER 24 Jul. 1994 5 p
(Contract(s)/Grant(s): F49620-92-J-0195)
(AD-A285353; AFOSR-94-0591TR) Avail: CASI HC A01/MF A01

The goal of the research has been to determine whether there is evidence of a diffusible coupling signal from the Suprachiasmatic Nucleus. If a diffusible signal is physiologically significant, it has the potential for use as a bioactive agent for exogenous administration. We believe we now have evidence that such a signal exists, and that it can appear in biologically significant amounts in the cerebrospinal fluid. At the present time we are working to complete the most definitive experiments providing such proof. We are also working towards our next goal: to establish the experimental conditions for identifying the diffusible signal. DTIC

N95-22476# Helsinki Univ. of Technology, Espoo (Finland).

MAGNETIC SOURCE IMAGING OF VISUALLY EVOKED AND OSCILLATORY ELECTRICAL ACTIVITY OF THE HUMAN BRAIN Ph.D. Thesis

S. AHLFORS 6 Jun. 1994 148 p See also PB85-201036
(PB95-127205; ISBN-951-22-2150-0) Avail: CASI HC A07/MF A02

The aim of this thesis work was to develop biomagnetic recording and analysis techniques and to apply them to studies of visually-evoked and spontaneous electrical activity in the human brain. The magnetoencephalographic method was applied to studies of the human visual cortex and oscillatory brain activity. Cerebral source currents evoked by simple, passively viewed checkerboard stimuli were found to be distributed over large regions of the cortex, showing complex variations as a function of time. The usefulness of minimum-norm estimates was evident in cases in which a multitude of sources overlap, both when giving a 2D estimate of the primary current distribution and when providing a standard representation of the measured magnetic field. With retinotopically organized stimuli, some of the difficulties inherent in the biomagnetic inverse problem could be overcome. Similar differentiation of the underlying source patterns should be possible in future studies by varying other stimulus properties as well. NTIS

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BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

A95-72259
DESIGNING INSTRUCTIONAL SIMULATIONS: EFFECTS OF INSTRUCTIONAL CONTROL AND TYPE OF TRAINING TASK ON DEVELOPING DISPLAY-INTERPRETAION SKILLS
JOSEPH S. MATTOON Armstrong Laboratory, Mesa, AZ, US International Journal of Aviation Pyschology (ISSN 1050-8414) vol. 4, no. 3 1994 p. 189-209
(HTN-95-40882) Copyright

Instructional simulation is a useful training medium for developing complex skill, but principles are needed to specify the most effective strategies for representing complex tasks and controlling instruction and simulation events within these learning environments. Different types of instructional control and training tasks were examined in three experiments. Adult subjects were taught how to use radar information shown on simulated cockpit displays to estimate the location and heading of target symbols on a computer screen. Overall, program control and part-task training strategies produced the best performance on this task. Author (Herner)

A95-72260* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
STRATEGIC WORKLOAD MANAGEMENT AND DECISION BIASES IN AVIATION
MIREILLE RABY Battelle Human Factors Transportation Center, Seattle, WA, US and CHRISTOPHER D. WICKENS University of Illinois, Urbana, IL, US International Journal of Aviation Pyschology (ISSN 1050-8414) vol. 4, no. 3 1994 p. 211-240 Research sponsored by the Air Force Aeromedical Research Laboratory
(Contract(s)/Grant(s): NAG2-308)
(HTN-95-40883) Copyright

Thirty pilots flew three simulated landing approaches under conditions of low, medium, and high workload. Workload conditions were created by varying time pressure and external communications requirements. Our interest was in how the pilots strategically managed or adapted to the increasing workload. We independently assessed the pilot's ranking of the priority of different discrete tasks during the approach and landing. Pilots were found to sacrifice some aspects of primary flight control as workload increased. For discrete tasks, increasing workload increased the amount of time in performing the high priority tasks, decreased the time in performing those of lowest priority, and did not affect duration of performance episodes or optimality of scheduling of tasks of any priority level. Individual differences analysis revealed that high-performing subjects scheduled discrete tasks earlier in the flight and shifted more often between different activities. Author (Herner)

A95-72261
INDIVIDUAL DIFFERENCES IN PILOT SITUATION AWARENESS
MICA R. ENDSLEY Texas Tech University, Lubbock, TX, US and CHERYL A. BOLSTAD Monterey Technologies, Inc., Cary, NC, US International Journal of Aviation Pyschology (ISSN 1050-8414) vol. 4, no. 3 1994 p. 241-264 Research sponsored by the Northrop Corporation
(HTN-95-40884) Copyright

Although anecdotal evidence has suggested considerable individual differences in the abilities of pilots to acquire and maintain situation awareness (SA), specific research to validate this claim and investigate the locus of such differences is lacking. This article presents an initial investigation of individual differences in SA. A study was conducted in which experienced fighter pilots completed a battery of tests to measure their abilities along key dimensions hypothesized to be important for SA. These measures were compared to subjects' abilities in situation awareness. The presence of consistent individual differences in SA abilities was supported and several key abilities were identified. Author (Herner)

A95-72262* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ANATOMY OF A SYSTEM ACCIDENT: THE CRASH OF AVIANCA FLIGHT 052
ROBERT L. HELMREICH The University of Texas at Austin, Austin, TX, US International Journal of Aviation Pyschology (ISSN 1050-8414) vol. 4, no. 3 1994 p. 265-284
(Contract(s)/Grant(s): NCC2-286; FAA-92-G-017)
(HTN-95-40885) Copyright

On January 25, 1990, Avianca Flight 052 crashed after running out of fuel following a missed approach to New York's John F. Kennedy Airport. Weather was poor on the East Coast of the United States that day, and the flight had experienced several holding patterns enroute from Medellin, Colombia, to New York. The accident is analyzed in terms of Helmreich and Foushee's (1993) model of crew performance and Reason's (1990) model of latent pathogens in system operations. Author (Herner)

A95-72263
EFFECTIVENESS OF PC-BASED FLIGHT SIMULATION
GUSTAVO A. ORTIZ Andrews University, Berrien Springs, MI, US International Journal of Aviation Pyschology (ISSN 1050-8414) vol. 4, no. 3 1994 p. 285-291
(HTN-95-40886) Copyright

PC-based flight-simulation effectiveness was analyzed through a transfer-of-learning study. Sixty college students with no previous flight experience performed a designated-aircraft maneuver. Thirty of the subjects were trained in a computer-based training device (CBTD) before flying; the remaining 30 were taken directly to the aircraft. Chi-square and t test analyses on the data revealed a statistical advantage at the .01 level of confidence for the CBTD-trained experimental group, which performed significantly better than the control group. The CBTD chosen for this study was AzureSoft's Electronic Instrument Flight Rules Environment (ELITE), run on a Zenith personal computer. Cessna 150 and 152 aircraft were used for the flight portion of the study. The incorporation of CBTDs in flight training is recommended because they have the potential for reducing the amount of hours spent in the airplane. Author (Herner)

A95-72573
PILOT-CANDIDATE SELECTION METHOD: SOURCES OF VALIDITY
THOMAS R. CARRETTA Armstrong Lab., Brooks AF Base, TX, US and MALCOLM JAMES REE Armstrong Lab., Brooks AF Base, TX, US International Journal of Aviation Psychology (ISSN 1050-8414) vol. 4, no. 2 1994 p. 103-117
(HTN-95-A0502) Copyright

Six hundred seventy-eight Air Force pilot training candidates were tested with a paper-and-pencil aptitude battery and computer-administered tests of psychomotor skills, information processing, and attitude toward risk. A self-report of flying experience was also collected. These data were used in regression analyses to determine which variables provided the best prediction of two flying criteria: pass-fail flying training, and class rank at the end of flying training. The paper-and-pencil tests were found to be the best predictors. The measures of flying experience, psychomotor skills, and attitude toward risk incremented the prediction of the criteria above the prediction provided by the paper-and-pencil tests by 23%. Computer-administered information-processing measures were not found to be incremental to the other variables in the prediction of the criteria. Author (Herner)

A95-72574
HUMAN PERFORMANCE IN ACTUATING SWITCHES DURING TRACKING
JAMES R. BUCK Iowa Univ., Iowa City, IA, US, DAVID R. PAYNE Dynamics Research Corp., US, and JAMES W. BARANY Purdue

Univ., US International Journal of Aviation Psychology (ISSN 1050-8414) vol. 4, no. 2 1994 p. 119-139
(HTN-95-A0503) Copyright

The objectives of this study were to develop an engineering model of pilotage performance times in actuating switches and to test the feasibility of its use in task time-line analysis. A low-fidelity environment was simulated. Compensatory tracking was used to approximate the concurrent task of aircraft control corrections to turbulence during straight-level flight. Variables that affected time and tracking performance were identified for use in predicting performance. Several desired features of switch-actuation performance times were investigated for prediction purposes. Our experimental results confirmed that the most needed and desired features existed or well approximated for estimating performance times in these analyses for use during early stages of aircraft design. The engineering model should offer improved efficiency to task time-line analysis. Tracking errors were analyzed to estimate the vision and attention requirements of the variations in switch-actuation tasks. Author (Herner)

A95-72575
EXPERIMENTAL STUDY OF ELECTRONICALLY BASED INSTRUMENT APPROACH PLATES
MARK G. MYKITSHYN Massachusetts Inst. of Tech., Cambridge, MA, US, JAMES K. KUCHAR Massachusetts Inst. of Tech., Cambridge, MA, US, and R. JOHN HANSMAN Massachusetts Inst. of Tech., Cambridge, MA, US International Journal of Aviation Psychology (ISSN 1050-8414) vol. 4, no. 2 1994 p. 141-166
(Contract(s)/Grant(s): DTRS57-88-C-00078)
(HTN-95-A0504) Copyright

Issues associated with the electronic presentation of instrument approach plates (IAPs) were investigated in a part-task simulation study using the Massachusetts Institute of Technology Aeronautical Systems Laboratory's Advanced Cockpit Simulator. Several electronic IAP chart formats were developed and evaluated. A decluttering system that allowed the pilots to selectively suppress various information groups in some of the prototype formats was also investigated. Results of the experimental study indicated that there was no degradation, and possibly a limited gain in information-retrieval performance when IAP information was presented in electronic format and compared to traditional paper IAPs. Each pilot preferred the selectable decluttering feature. The preferred chart was a color, north-up (nonmoving map) format with the decluttering capability. During the simulation, low levels of terrain situational awareness were observed when pilots were given erroneous air traffic control vectors toward hazardous terrain. Author (Herner)

A95-72576
MILITARY AEROMEDICAL PSYCHOLOGY TRAINING
STEPHEN V. BOWLES Army School of Aviation Medicine, Fort Rucker, AL, US International Journal of Aviation Psychology (ISSN 1050-8414) vol. 4, no. 2 1994 p. 167-172
(HTN-95-A0505) Copyright

The Aeromedical Psychology Training Course (APTC) has been developed to provide selected clinical psychologists with specialized training in the fundamentals and application of aeromedical psychology. The APTC was implemented in Fiscal Year 1992 under the sponsorship of the U.S. Army Office of the Surgeon General, and hosted by the U.S. Army School of Aviation Medicine, Fort Rucker, Alabama. This article discusses the objectives of the course, the course curriculum, and the skills than an aeromedically trained psychologist may offer aviation medicine. Author (Herner)

A95-72577
CROSSCULTURAL PERSPECTIVES IN HUMAN FACTORS TRAINING: LESSONS FROM THE ICAO HUMAN FACTORS PROGRAM
DANIEL E. MAURINO International Civil Aviation Organization, Montreal, Canada International Journal of Aviation Psychology (ISSN 1050-8414) vol. 4, no. 2 1994 p. 173-181
(HTN-95-A0506) Copyright

Since 1991, the International Civil Aviation Organization (ICAO) has conducted four human factors training seminars and supported numerous events on the same topic in virtually every region of the world. This has provided significant information on perceptions, needs, and obstacles regarding human factors training as expressed by operational personnel, regulators, and managers across the international aviation community. This article presents these different perspectives from a practitioner's point of view. The cultural issues identified are deemed of value in contributing to orient the direction and design of future human factors training endeavors, especially those targeted to other than North American audiences. Author (Herner)

N95-19887 Carnegie-Mellon Univ., Pittsburgh, PA. School of Computer Science.
A DATABASE FOR ANALYZING SEQUENTIAL BEHAVIORAL DATA AND THEIR ASSOCIATED COGNITIVE MODELS
BONNIE E. JOHN 15 May 1994 24 p Revised Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(AD-A280061; CMU-CS-94-127; CMU-HCII-94-101) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

Sequential behavioral data, be it verbal protocols, automatically-recorded keystrokes, or complete videotape protocols, can be analyzed at different levels of detail and from different viewpoints. If raw behavioral data is stored in a powerful database, rather than a simple text file, many domains will allow some automatic interpretation of that data. In addition, the raw data can be compared with traces of an associated computational cognitive model to assess how well the model accounts for the data and, conversely, how much support the behavioral data provides for the components of the model. This report describes a prototype database and user interface, called Trace & Transcription, that is designed to facilitate protocol analysis and cognitive modeling. This research was supported in part by a grant from US West Advanced Technologies Sponsored Research Program. The views and conclusions contained in this document are those of the author and should not be interpreted as representing the official policies, either expressed or implied, of US West. DTIC

N95-19957# Naval Aerospace Medical Research Lab., Pensacola, FL.
TEST RELIABILITY AND EXPERIMENTAL POWER
R. R. STANNY Dec. 1993 15 p
(AD-A279607; NAMRL-SP-93-7) Avail: CASI HC A03/MF A01

The reliability coefficient, rho(sub xx), has long been accepted as an index of the stability, repeatability, and precision of psychological tests. Because rho(sub xx) measures the proportion of the variance in a set of scores attributable to variation among individuals, values of rho(sub xx) are sometimes compared to justify using particular tests in studies of individual differences. Values of rho(sub xx) are also sometimes compared to justify using particular tests in experimental research. The latter practice is usually justified by arguing that larger values of rho(sub xx)) imply greater measurement precision and, therefore, potentially greater sensitivity to experimental treatments. That argument is not generally correct because the individual variation measured by rho(sub xx) is frequently confounded with measurement error in the denominators of significance tests. The effects of this confounding lead to 'paradoxical' situations in which reliability, as measured by rho(sub xx), may be inversely related (or unrelated) to experimental precision, as measured-by the reciprocal of experimental error. Because the power of an experiment increases with precision, as just defined, conditions that invert or negate the relationship between rho(sub xx) and precision also invert or negate the relationship between rho(sub xx) and power. These considerations do not mean that the reliability coefficient is necessarily irrelevant to experimental research. Because experimental designs differ in the degree to which they are influenced by individual variation, a consideration of the value of

rho(sub xx)) a specific test yields will sometimes provide information about the best design in which to use that test. DTIC

N95-19970# Air Force Materiel Command, Brooks AFB, TX. Human Resources Directorate.
INTELLIGENT TUTORING SYSTEMS: PAST, PRESENT, AND FUTURE Interim Report, Apr. 1993 - Apr. 1994
VALERIE J. SHUTE and JOSEPH PSOTKA May 1994 69 p Submitted for publication
(Contract(s)/Grant(s): AF PROJ. 2313)
(AD-A280011; AL/HR-TP-1994-0005) Avail: CASI HC A04/MF A01

In this paper, we address many aspects of Intelligent Tutoring Systems (ITS) in our search for answers to the following main questions: (1) What are the precursors of ITS?; (2) What does the term mean?; (3) What are some important milestones and issues across the 20+ year history of ITS?; (4) What is the status of ITS evaluations?; and (5) What is the future of ITS? We start with an historical perspective. DTIC

N95-19998# Harvard Univ., Cambridge, MA. Dept. of Psychology.
INTERMEDIATE LEVELS OF VISUAL PROCESSING Annual Report, 1 Oct. 1992 - 30 Sep. 1993
KEN NAKAYAMA 30 Sep. 1993 3 p
(Contract(s)/Grant(s): F49620-92-J-0016)
(AD-A284922; AFOSR-94-0622TR) Avail: CASI HC A01/MF A01

Over the past year we have completed a number of studies on surface perception and visual attention. Although the two have been studied in isolation, during the latter part of our investigation, we have found some surprising relationships between the two. DTIC

N95-20007# South Carolina Univ., Columbia, SC. Dept. of Psychology.
ROLE OF WORKING MEMORY LIMITATIONS OF RETRIEVAL Annual Technical Report, May 1993 - May 1994
RANDALL W. ENGLE 12 May 1994 10 p
(Contract(s)/Grant(s): F49620-93-1-0336)
(AD-A280032; AFOSR-94-0332TR) Avail: CASI HC A02/MF A01

Over the past year, 11 studies have been completed on the role of working memory limitations on storage retrieval of information. One series demonstrated that, if subjects are highly trained and there is no interference among the items being retrieved, working memory limitations play no role in retrieval. However if there is interference among the information being retrieved, individuals low in working memory capacity suffer in retrieval from active memory compared to high working memory individuals. Regardless of interference condition, however, working memory capacity plays no role in retrieval from inactive or secondary memory. A second series of studies demonstrated that the phonological similarity effect, one of the primary sources of evidence for the articulatory loop, is not found if the words in the lists to be recalled are chosen from an unlimited set and presented silently. This casts doubt on the generality of this code, particularly for silent reading. DTIC

N95-20062# Air Force Materials Lab., Wright-Patterson AFB, OH. Crew Systems Directorate.
THE SPATIOTEMPORAL CHARACTERISTICS OF VISUAL MOTION PRIMING Final Report, Aug. 1991 - Aug. 1992
ALAN R. PINKUS Jul. 1994 100 p
(Contract(s)/Grant(s): AF PROJ. 6893)
(AD-A284782; AL/CF-TR-1994-0084) Avail: CASI HC A05/MF A02

A motion signal that is produced from a sine-wave luminance grating which has undergone an abrupt 90-degree phase shift (frames 1 to 2) can serve as a priming signal that disambiguates motion of a second, 180-degree (counterphase) shift (frames 2 to 3). Four experiments investigated the spatiotemporal characteristics of this phenomenon which is termed visual motion priming (VMP). Experiment 1 varied the phase-shift magnitude of the priming signal from 22.5 through 157.5 degrees. This resulted in an inverted U-shaped half-sine function that peaked at 90 degrees with 93.5% priming. Experiment 2 varied frame 2 duration (192, 384, 768, and 1530 ms), spatial frequency (0.7, 1.4, and 2.8 cycles/degree), and used 19 or 48% contrast for the 3 frames. VMP decreased monotonically from about 94% at 192 ms to near 50% (chance level) at 768 and 1530 ms. Duration and spatial frequency were significant, but contrast had no systematic effect. Experiment 3 varied the ratio of frame 1 contrast (4, 6, 13, 19, 30, 48%) relative to frames 2 and 3, where both of the latter two frames had either 19 or 48% contrast. Several effects were observed. When the ratio of the contrasts between frames 1 and 2 was largest (4-48-48% contrast for frames 1-2-3, respectively), VMP was lowest at 82%. A smaller initial ratio, but a lower overall contrast level (4-19-19% contrast), resulted in a higher VMP of 91.5%. As the priming contrast ratios decreased to 1:4 or less, irrespective of overall contrast level, VMP quickly asymptoted. DTIC

N95-20064 Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
A 3D STEREO DATA VISUALIZATION AND REPRESENTATION M.S. Thesis
KAI-HENG WANG Sep. 1994 110 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(AD-A284788; AFIT/GCE/ENG/94S-01) Avail: CASI HC A06

This thesis investigates a technique for improving the perception and visualization of three dimensional information. This improvement will eventually give physicians the ability to both visualize and understand biomedical image data. Raw data is used to generate a stereo image pair. The raw data must be put in run length encoding (RLE) format and then converted to a stereo pair. Once the stereo pair is generated, they must be displayed on the Silicon Graphics ONYX workstation in stereo mode. This research uses 3D images of planets and satellites. The display information is transmitted across cable and is projected onto a spherical mirror, a real 3D stereo image can be observed. Biomedical data of interest to this research are slices of a volume of tissue. To convert the slice information into volume data a representation that allows meaningful interpolation between the slices for stereo image pair generation is necessary. A second thrust of this thesis is to investigate neural networks and Kriging algorithm for potential use in interpolation of the biomedical volume data. DTIC

N95-20314 California Univ., Santa Cruz, CA. Dept. of Psychology and Psychobiology.
SPACE CONSTANCY ON VIDEO DISPLAY TERMINALS Final Report, 1 Jan. - 31 Dec. 1991
BRUCE BRIDGEMAN 28 Apr. 1994 24 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(Contract(s)/Grant(s): AF-AFOSR-0095-90; AF PROJ. 2313)
(AD-A280015; AFOSR-94-0331TR) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

Flicker of video display terminals (VDT's) has several consequences for visual function: space perception is distorted, and reading is slowed. We first tested the hypothesis that the flicker of VDT's interferes with visual space constancy, the perception that the world remains in the same place despite eye movements. Space constancy was probed by moving targets during eye movements, and noting a difference in movement threshold that depended upon whether a target jumped in the same direction as the eye or the opposite direction. Flicker rates up to 260 Hz distorted perception in a direction that implies breakdown of space constancy. Another experiment investigated the roles of color and luminance mechanisms in space constancy. The conclusion was that perception is actively suppressed during eye movements. The suppression depends on channels in the visual system that are insensitive to chromatic differences. Reading with 60 Hz flicker was 3.05% slower than with 500 Hz flicker. The result is consistent with a hypothesis that under flicker the eye 'parks' following an eye movement, until a

new sample of text appears. Processing then proceeds in the usual way. The results allow quantitative predictions of reading speed at an flicker rate. DTIC

N95-20393# Maryland Inst. for Emergency Medical Services, Baltimore, MD.
DEVELOPMENT AND ENHANCEMENT OF A MODEL OF PERFORMANCE AND DECISION MAKING UNDER STRESS IN A REAL LIFE SETTING Annual Report, 1 Oct. 1993 - 30 Sep. 1994
COLIN F. MACKENZIE Sep. 1994 7 p
(Contract(s)/Grant(s): N00014-91-J-1540)
(AD-A285945) Avail: CASI HC A02/MF A01

We have concentrated our analysis on 50 of over 100 videotapes acquired of trauma patient resuscitation and anesthesia. The management of the airway (tracheal intubation) in these 50 videotapes was classified into three types of situations: (1) emergency (less than 10 min after patient admission); (2) semi-emergency (less than 30 min after patient admission); and elective. Such a classification allowed us to contrast the impact of stress on performance and team activity. As a result of this analysis, several factors have been illustrated that may have contributed to untowarded incidents, identified the impact of task complexity on team coordination patterns, and investigated the linkage between task performance and communication failures. Derived from text

N95-20609# Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Soesterberg (Netherlands). Human Factors Research Inst.
A COMPARISON OF DECISION MAKING BEHAVIOUR IN A STATIC AND A DYNAMIC TASK ENVIRONMENT AS A FUNCTION OF TIME PRESSURE Interim Report [EEN VERGELIJKING VAN BESLISGEDRAG IN EEN STATISCHE EN EEN DYNAMISCHE TAAKOMGEVING ALS FUNCTIE VAN TIJDSDRUK]
J. H. KERSTHOLT and A. R. PIETERS 20 May 1994 25 p
(AD-A285389; TNO-TM-1994-B-10; TDCK-94-0052) Avail: CASI HC A03/MF A01

Decision making research shows an increasing interest for time-dependent decisions. In contrast with decision making in static tasks, where, based on the available information, only one decision needs to be made, dynamic environments offer the possibility to adjust incorrect decisions through continuous feedback on the overall system state. It is therefore to be expected that the outcome performance will be better in a dynamic than in a static task environment. Previous research indicates that decision makers adjust their mental activities to the demands of the decision environment. Since dynamic environments offer the possibility for corrective actions, in contrast to static environments, it was predicted that cognitive performance would be worse in a dynamic task, on the assumption that people want to make accurate decisions with minimal mental effort. Furthermore, as it was assumed that the advantages of dynamic environments would reduce as time pressure increased, we predicted that both outcomes and cognitive performance would be more equal in dynamic and static tasks as time pressure increased. In an experiment two versions of a similar diagnosis task were used: a static and a dynamic one. In the dynamic task version subjects decided in real time, and they saw a graph on a computer screen indicating the state of the system. In the static task version, subjects did not get this information and their task was to make one diagnosis per trial. DTIC

N95-20845# Boston Univ., MA.
NEURAL MODELS OF MOTION PERCEPTION Annual Technical Report, 1 Sep. 1993 - 31 Aug. 1994
STEPHEN GROSSBERG and ENNIO MINGOLLA Nov. 1994 9 p
(Contract(s)/Grant(s): F49620-92-J-0334)
(AD-A286560; AFOSR-94-0720TR) Avail: CASI HC A02/MF A01

Six research projects supported by this grant during the reporting period have resulted in one published book chapter, one refereed article in press, two articles under review, and five conference publications. Areas of research included design and simulation of network architectures for: (1) spatial pooling and perceptual framing by synchronized cortical dynamics; (2) synthetic aperture radar processing by a multiple scale; (3) formation of cortical maps of ocular dominance and orientation columns; (4) a neuron model with variable ion concentrations; (5) a multi-scale model of brightness perception; and (6) models of motion perception. DTIC

N95-21101# State Univ. of New York, Stony Brook, NY. Dept. of Psychology.
SIGNAL- AND LISTENER- BASED FACTORS IN COMPLEX AUDITORY PATTERN PERCEPTION Final Technical Report, 15 Sep. 1991 - 14 Aug. 1994
ARTHUR G. SAMUEL 23 Sep. 1994 13 p
(Contract(s)/Grant(s): AF-AFOSR-0378-91)
(AD-A285636; AFOSR-94-0644TR) Avail: CASI HC A03/MF A01

The research project was designed to delineate principles that underlie the perception of complex auditory patterns. During the granting period, nine lines of research were conducted that investigated various aspects of complex auditory perception. These research efforts largely focussed on perception of speech sounds, and provided important information about three aspects of perception. Several of the projects clarified the role that the listener's knowledge of English words can play in decoding speech. Additional studies examined how lower-level representations (spectral patterns, high-frequency sublexical patterns) are processed. Across a number of the research efforts, attentional effects were investigated, to determine how they modulate other processing. Collectively, the research effort made significant progress in clarifying how human listeners decode very complex sounds. DTIC

N95-21192# Wright State Univ., Dayton, OH. Dept. of Psychology.
PERCEPTION AND CONTROL OF LOCOMOTION Annual Technical Report, 1 Sep. 1993 - 31 Aug. 1994
JOHN M. FLACH 30 Sep. 1994 12 p
(Contract(s)/Grant(s): F49620-93-1-0560)
(AD-A285605; WSU/ATR/662480; AFOSR-94-0648TR) Avail: CASI HC A03/MF A01

This report describes an empirical study to evaluate the ability to track a constant altitude as a function of the structure in optical flow (Manipulated using types of ground texture - splay, depression, dot, and block and the rate of forward motion - global optical flow (GOF) rate). Subjects were asked to track a constant altitude (25 ft) in the face of disturbances to the vertical, lateral, and fore-aft axes. The critical independent variables were texture type and GOF rate. Texture type was manipulated within subjects and GOF rate was manipulated between subjects. Dependent variables included RMS altitude error and correlated control power. The results showed a crossover interaction. For both dependent measures, performance at 0 GOF rate was best with depression angle and poorest with splay angle. The reverse was true at a GOF rate of 3 eyeheights/s. The results are consistent with the hypothesis, suggested by Flach et al. (1992), that the ability to pick-up information about altitude from optic flow depends on the amount of optical flow activity specific to altitude (signal) relative to the flow activity arising from other factors (e.g., motion in the fore-aft and lateral axes) (noise). The optical flow that results from forward motion (GOF rate) is visible in the depression, dot and block textures. This 'noise' makes it more difficult to differentiate the optical activity specific to changes in altitude. With splay texture, there is no change in the flow as a result of forward motion. Therefore, performance with splay texture is independent of GOF rate. DTIC

N95-21284 Technical Research Centre of Finland, Espoo (Finland).
13TH EUROPEAN ANNUAL CONFERENCE ON HUMAN DECISION MAKING AND MANUAL CONTROL
LEENA NORROS, ed. May 1994 222 p Conference held in Espoo, Finland, 13-14 Jun. 1994
(ISSN 0357-9387)

(PB95-132874; VTT/SYMPOSIUM-146; ISBN-951-38-4097-2) Copyright Avail: Issuing Activity (National Technical Information Service (NTIS))

Contents include the following: Task allocation problems in human-centered automation systems; Use of a questionnaire for the modelization of trust in a man-machine system; Human reliability in civil aviation; Towards a method to analyze cognitive errors during accident management: A taxonomy of cognitive errors; Misdiagnosis is not the only diagnostic error mode; Towards a computer-based decision making system for conceptual design; The COMMONKADS method for the analysis and the modelling of the expertise in a design activity; Decision support for planning rehabilitation in hydro power production systems; Methodology for robotic software design; Computer support for sharing expertise in process disturbances; Towards a new way of presenting information to a supervision system; Design of dynamic display systems for process plants; The integration of peripheral vision concepts into conventional display design; KSM-SUPPORT - A real time, fault diagnosis system for an absorption heat transformer; Fuzzy characterization of the human operator for a decision support system in teleoperation; Conceptual mastery of work, mastery of disturbance handling, and their development among personnel in paper production; Collective activities and reliability; Knowledge acquisition and case-based reasoning: An integrated approach; and A method for analysis of nuclear power plant operators' decision making in simulated disturbance situations. NTIS

N95-21927 Army Aeromedical Research Lab., Fort Rucker, AL.
FACTORS THAT DETERMINE VISUAL ACUITY THROUGH NIGHT VISION GOGGLES FOR EMMETROPES
JOHN C. KOTULAK and STEPHEN E. MORSE Apr. 1994 30 p
Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(AD-A279339; USAARL-94-16) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

Many factors which could affect visual acuity (VA) with night vision goggles (NVG's) already have been studied, e.g., night sky condition and target contrast (Levine and Rash, 1989a and 1989b; Wiley, 1989; Kotulak and Rash, 1992), NVG generation (Miller et al., 1984; Kotulak and Rash, 1992), nuclear flashblindness protection (Levine and Rash, 1989a and 1989b), chemical protective masks (Miller et al., 1989; Donohue-Perry, Riegler, and Hausman, 1990), signal-to-noise ratio (Riegler et al., 1991), interpupillary distance misadjustment (King and morse, 1992), and instrument myopia (Kotulak and Morse, 1992, 1994a, and 1994b; Kotulak, Morse, and Wiley, 1993). Another factor which could influence NVG VA is decreased unaided VA, i.e., VA without NVG's; however, relatively little is known about it. DTIC

N95-21968 Army Armament Research, Development and Engineering Center, Watervliet, NY.
HOW THE BRAIN WORKS Final Report
RAYMOND SCANLON and MARK JOHNSON Feb. 1994 31 p
Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(AD-A279138; ARCCB-TR-94006) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

The vertebrate brain is explained as an assemblage of neurons, each responsive only to those afferent upon it. Thought is shown to proceed without a homunculus. DTIC

N95-22052# Northwestern Univ., Evanston, IL. Inst. for the Learning Sciences.
MAC/FAC: A MODEL OF SIMILARITY-BASED RETRIEVAL Technical Report, 1 Sep. 1989 - 31 Oct. 1992
KENNETH D. FORBUS, DEDRE GENTNER, and KEITH LAW Oct. 1994 67 p
(Contract(s)/Grant(s): N00014-89-J-1272)
(AD-A286291; TR-59) Avail: CASI HC A04/MF A01

We present a model of similarity-based retrieval that attempts to capture these seemingly contradictory psychological phenomena: (1) structural commonalities are weighed more heavily than surface commonalities in soundness or similarity judgments (when both members are present); (2) superficial similarity is more important in retrieval from long-term memory than is structural similarity; and yet (3) purely structural (analogical) remindings are sometimes experienced. Our model, called MAC/FAC (for many are called but few are chosen) consists of two stages. The first stage (MAC) uses a computationally cheap, nonstructured matcher to filter candidates from a pool of memory items. We redundantly encode structured representations as content vectors, whose dot product yields an estimate of how well the corresponding structural representations will match. The second stage (FAC) uses SME to compute a true structural match between the probe and output from the first stage. MAC/FAC has been fully implemented and tested on dozens of examples. We show that MAC/FAC is capable of modeling patterns of access found in psychological data, and illustrative via sensitivity analyses that these results exhibit the desired dependence on theoretically important factors. The relationship of MAC/FAC to other models of memory is discussed, along with implications and possible extensions. DTIC

N95-22323# Army Medical Research Unit (Europe).
PSYCHOSOCIAL STRESS AND MENTAL HEALTH IN A FORWARD-DEPLOYED MILITARY COMMUNITY
PAUL T. BARTONE, MARK A. VAITKUS, and ROBERT C. WILLIAMS Jul. 1994 14 p
(AD-A285940; WRAIR-TR-94-0020) Avail: CASI HC A03/MF A01

The impact of perceived stressful experiences on mental health was studied using 1993 survey data from a representative sample (N=5,235) of the Army population in Europe. Regression results show stress in various life areas (personal, job, family) strongly predicts depression. Stress associated with mandated force reductions is also a predictor of depression for soldiers with children and working spouses. This study demonstrates empirically that stress associated with military force reductions is related to negative mental health effects. DTIC

N95-22324# Army Medical Research Unit (Europe).
ASSESSING POST TRAUMATIC STRESS DISORDER AND PTSD SYMPTOMATOLOGY IN US ARMY PERSONNEL
PAUL T. BARTONE, MARK A. ADLER, and MARK A. VAITKUS 11 Jun. 1994 17 p
(AD-A285941; WRAIR-TR-94-0019) Avail: CASI HC A03/MF A01

This poster presentation reports on selected findings from a large-scale survey study of U.S. Army Gulf War veterans, showing that combat exposure is related to PTSD 'caseness' for substantial numbers of soldiers. In defining PTSD, the diagnostic algorithm contained in DSMIII-R was followed, using appropriate self-reported symptoms from two scales in the soldier survey. While this PTSD scale was adequate to the purpose, some of the items were less than exact matches to the DSM3-R listed symptoms. For future work, a more precise set to DSMIII-R (and now, DSMIV) based items are needed. A review of relevant studies shows that DSM-based PTSD checklists perform very well compared to other self report measures (e.g., Mississippi Scale) in identifying clinically diagnosed cases, and in terms of sensitivity and specificity. A team of researchers at the US Army Medical Research Unit-Europe has developed a new PTSD checklist and scoring procedures for use in future soldier studies. The scale is presented along with recommendations for its use. DTIC

N95-22472# Columbia Univ., New York, NY. Dept. of Psychology.
VISUAL PERCEPTION OF ELEVATION Final Report, 1 Jan. 1991 - 30 Jun. 1994
LEONARD MATIN 29 Aug. 1994 13 p
(Contract(s)/Grant(s): AF-AFOSR-0146-91)
(AD-A284938; REPT-003; AFOSR-94-0565TR) Avail: CASI HC A03/MF A01

The work at Columbia has concentrated on 4 matters: (1) Experimental work aimed at determining the aspects of individual lines and combinations of lines in the visual field that generate the

substantial influence on the visual perception of eye level (VPEL); (2) Experimental work aimed at determining the aspects of individual lines and combinations of lines on the visual perception of the vertical (VPV) and visually perceived straight ahead (VPSA) and their connections with the VPEL; (3) Experimental work aimed at measuring the involvement of extraretinal control of VPEL including effects of head and eye position; and (4) Theoretical work on a quantitative model of the mechanism controlling the visual influence on VPEL, VPV, and VPSA, the Great Circle Model (GCM). DTIC

N95-22473# California Univ., Berkeley, CA. School of Optometry.
SPATIO-TEMPORAL MASKING IN HUMAN VISION AND ITS APPLICATION TO IMAGE CODING Annual Technical Report
STANLEY KLEIN and D. A. SILVERSTEIN Aug. 1994 3 p
(Contract(s)/Grant(s): F49620-92-J-0359)
(AD-A284949; AFOSR-94-0555TR) Avail: CASI HC A01/MF A01

Before an image is stored or transmitted, we have access to the original and the distorted versions. The enhanced codec is compared to the original block by block to determine which blocks have been improved by the enhancement. These blocks are then flagged for post-processing in a way that is compliant with the JPEG standard and adds nothing to the compressed image's bandwidth. The end result is a compressed image that can be decompressed on any standard JPEG decompressor, but that can be enhanced by a sophisticated decompressor. For the comparison of the original and enhanced images, we have been developing a new vision model that is specifically tailored to the detection of errors that occur within or between two JPEG codec blocks. Previous filter models have been restricted from using a large number of filters due to computational constraints which we avoid by focusing the model on a tiny spatial area of 8x16 pixels. Further, features of human vision that have been included in previous models (color, temporal, stereo, etc.) are not needed for this more focused problem. Issues that have not been completely addressed by previous models, such as masking effects, are tractable and the model is more applicable to JPEG compression. DTIC

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MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

N95-20041 Naval Postgraduate School, Monterey, CA.
PERSONAL COMPUTER AND WORKSTATION OPERATING SYSTEMS TUTORIAL M.S. Thesis
CHARLES E. FRAME, JR. Mar. 1994 154 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(AD-A280132) Avail: CASI HC A08

This thesis is a review and analysis of personal computer and workstation operating systems. The emphasis is placed on UNIX, MS DOS, MS Windows and OS/2 operating systems. UNIX is covered under the U.S. Government POSIX standard, which dictates its use when practical. MS DOS is the most used operating system worldwide. OS/2 was developed to combat some of the shortcomings of MS DOS. Each operating system which is discussed has a design philosophy that fulfills specific user's needs. UNIX was designed for many users sharing a computer system. MS DOS, MS Windows and OS/2 are designed as single user computer systems. All of these operating systems are in use at the Naval Postgraduate School. All of the operating systems are discussed with regard to their: history of development, process management, file system, input and output system, user interface, network capabilities, and advantages and disadvantages. UNIX has a section devoted to the POSIX standard and MS DOS has a section devoted to Windows 3.1. Apple Corporation's System 7 is mentioned throughout the text, but is not covered in detail. DTIC

N95-20276 Technical Research Centre of Finland, Espoo (Finland).
FORCE BASED MOTION CONTROL OF A WALKING MACHINE Ph.D. Thesis
H. LEHTINEN 1994 164 p
(PB95-129672; VTT/PUB-179) Copyright Avail: Issuing Activity (National Technical Information Service (NTIS))

Force control of legs of evolving walking machines is assumed to be essential in natural soft and uneven terrain. The large and varying amount of friction in the leg mechanisms while the body is carried and the practical delays and saturation in the hydraulic system increase the complexity of the process to be controlled. The main contributions in the thesis are as follows. The body forces are transformed to the supporting legs in two phases: sets of minimum forces perpendicular to the resultant body force and forces parallel to the same resultant. This method minimizes the possibility of slippage with walking machines, where the desired body force is often close to vertical due to the weight of the body. A load adaptive performance index (PI) force control method for the hydraulic actuation system of MECANT I consisting of an asymmetric cylinder and a symmetrical valve has been developed. The I term of the controller is changed according to the desired load. A rule based altitude controller and a dead-zone and saturation based attitude controller have been designed. The first tests with force controlled vertical actuators show the usability of the method and fast responses to deviations in body orientation. NTIS

N95-20562 Drexel Univ., Philadelphia, PA. Dept. of Electrical and Computer Engineering.
DESIGNING THE ARCHITECTURE OF HIERACHICAL NEURAL NETWORKS MODEL ATTENTION, LEARNING AND GOAL-ORIENTED BEHAVIOR Final Report, 1 Nov. 1988 - 31 Dec. 1993
ALLON GUEZ 31 Dec. 1993 23 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(Contract(s)/Grant(s): AF-AFOSR-0010-89)
(AD-A279898; AFOSR-94-0329TR) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

During this period this grant partially supported 6 researchers, and resulted in over 21 publications. This unusually large activity is largely due to the enthusiasm of the researchers and their institution, Drexel University, which indirectly carried some of the financial burden. Neural or other learning architecture for real world, real time applications, necessarily employ feedback and thus deal with the unavoidable dilemma of identification versus stabilization or tracking. The major finding reported focuses on this tradeoff and how to optimally perform it. For linear time invariant finite dimensional systems they are able to perform on-line closed loop identification and tracking. If in addition the learning and tracking cost functions are quadratic they show these costs may be linearly scalarized without loss of optimality. DTIC

N95-20625 Army Research Lab., Aberdeen Proving Ground, MD.
EVALUATION OF STRESS EXPERIENCED BY SOLDIERS WEARING CHEMICAL PROTECTIVE CLOTHING DURING VARYING WORK LOADS IN DESERT OR TROPICAL ENVIRONMENTS Final Report
GERALD A. HUDGENS, LOUIS E. BANDERET, and BRUCE S. CADARETTE Apr. 1994 45 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(Contract(s)/Grant(s): AF PROJ. B74A)
(AD-A280113; ARL-TR-460) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

A stress evaluation was conducted in a laboratory test in which the physiological and psychological reactions of soldiers were monitored while they wore either the standard battle dress overgarment (MOPPI) or the full complement of chemical protective clothing

with mask (MOPPIV) and worked at low, moderate, or high work loads in simulated desert (hot and dry) or tropic (hot and humid) environments. The psychological instruments indicated greater stress responses for soldiers wearing MOPPIV than wearing MOPPI and for soldiers working at a high work load than working at a low work load. DTIC

N95-20768# Naval Command, Control and Ocean Surveillance Center, San Diego, CA. Research, Development, Test and Evaluation Div.
HUMAN PERFORMANCE STUDIES FOR CONTROL OF MULTIPLE REMOTE SYSTEMS Final Report
STEVEN A. MURRAY Jul. 1994 43 p
(AD-A286623; NCCOSC/RDT/E-TR-1658) Avail: CASI HC A03/MF A01

Many systems involving multiple remote sensors or machines require a single operator to control more than one device simultaneously. Interface design issues for operator support in such systems can be formidable, as the inherent task complexity creates significant opportunities for operator confusion and overload. A study was conducted to examine some of these issues, using a simulated industrial security environment as the applied setting. The operator task was to designate the number and location of intruders in a simulated building, using video information from remote sensor platforms. The experiment manipulated the number of displays which had to be monitored, event rate, image redundancy and sensor platform mobility. Response time increased significantly for increasing numbers of displays, as expected, but also increased independently for event rate image redundancy and for mobile sensors. Results showed that significant performance penalties may be encountered in multiple platform control, and that these penalties accumulate at seemingly low levels of complexity. DTIC

N95-20973# Logistics Management Engineering, Inc., Warminster, PA. Systems Engineering Group.
HELICOPTER CREWSEAT CUSHION PROGRAM Final Report
RICKY L. GRETH Nov. 1994 73 p
(Contract(s)/Grant(s): DAAJ02-92-C-0043)
(AD-A286654; USAATCOM-TR-94-D-11) Avail: CASI HC A04/MF A01

A large proportion of Army helicopter pilots suffer back pain caused by flying. Extended missions required during Desert Shield/Desert Storm emphasized this problem. This pain could have an adverse impact on operational readiness, crew effectiveness, and flight safety. Poor posture during flight has been a contributing factor in pilot lower back pain. This program was performed to develop a seat cushion that improves comfort and reduces the incidence of lower back pain without adversely affecting crashworthiness. A literature survey and fact finding study analyzed the problem as it relates to AH-64 pilots. The knowledge and design, however, should be useful in all helicopters, especially in those with crashworthy stroking seats such as the UH-60 and AH-64 and in the future, the Comanche. Conceptual designs were developed which could help alleviate the problem. A survey of materials identified a few foams which were best suited to satisfy most of the requirements identified. Additional laboratory testing of foams was conducted to better compare the final candidates and aid in determining the optimal thickness and density to be used for the bottom cushion. A fit and function evaluation determined appropriate size and range of adjustment required for each postural/comfort aid (thigh, lumbar, and arm support). Prototype cushions were designed and fabricated and were used in dynamic crash test and in an Army-conducted comfort evaluation. Final design modifications were made prior to fabricating the twelve deliverable cushion assemblies. DTIC

N95-21283 Technische Univ., Delft (Netherlands). Dept. of Industrial Design Engineering.
HUMAN FORCE EXERTION IN USER-PRODUCT INTERACTION. BACKGROUNDS FOR DESIGN Ph.D. Thesis
B. J. DAAMS 26 Apr. 1994 347 p See also AD-A233989
(PB95-132858) Copyright Avail: Issuing Activity (National Technical Information Service (NTIS))

The objective of this project is to suggest how an 'Atlas of Human Force Exertion' for use by designers should be set up, and to assess how far it can contribute to the design of consumer products. In addition, the objective is also to investigate the relations between the forces measured, and between those forces and anthropometric variables. From the nature of the objectives, the emphasis in this research is on the relation between research, results and design, and not so much on the interpretation of the results. The objective of the Atlas of Human Force Exertion is to provide designers with some information to enable them to improve their products on the aspects of force interaction with the user. Further assessment in how far the atlas can contribute to design is necessary to improve the definition of the ambitions, to adjust the expectations of the designers, and to find out whether it is worthwhile to invest time and money to make one. NTIS

N95-21358# Lawrence Livermore National Lab., Livermore, CA.
QUANTITATIVE EVALUATION OF WRIST POSTURE AND TYPING PERFORMANCE: A COMPARATIVE STUDY OF 4 COMPUTER KEYBOARDS
STEVE BURASTERO May 1994 7 p Presented at the 38th Annual Meeting of the Human Factors and Ergonomics Society, Nashville, TN, 24-28 Oct. 1994
(Contract(s)/Grant(s): W-7405-ENG-48)
(DE95-002392; UCRL-JC-117547; CONF-941086-3) Avail: CASI HC A02/MF A01

The present study focuses on an ergonomic evaluation of 4 computer keyboards, based on subjective analyses of operator comfort and on a quantitative analysis of typing performance and wrist posture during typing. The objectives of this study are (1) to quantify differences in the wrist posture and in typing performance when the four different keyboards are used, and (2) to analyze the subjective preferences of the subjects for alternative keyboards compared to the standard flat keyboard with respect to the quantitative measurements. DOE

N95-21467 National Defence Research Establishment, Stockholm (Sweden). Huvudavdelning foer Maensklig Prestation och Funktion.
NAVIGATION SYSTEM IN COMBAT VEHICLE [NAVIGERINGSSTOED I STRIDSFORDON]
U. HOERBERG Apr. 1994 19 p In SWAHILI
(PB95-131629; FOA-A-50023-5.2) Avail: Issuing Activity (National Technical Information Service (NTIS))

This study investigates the possibility to reduce, by means of different kinds of technical support, the workload of tank crew members, and in that way increase the capacity of the tank. Basic studies indicated that navigation and position location burdened the tank commander to such a degree that other important functions suffered. The effect of a navigation system on the tank commander's workload is therefore investigated here. The results indicate that in order to reduce the workload of the commander, a large part of the navigation and transportation functions have to be delegated to the tank driver. The driver's need for technical support is also discussed in the report. NTIS

N95-21566# Veda, Inc., Dayton, OH.
CREW-CENTERED COCKPIT DESIGN (CCCD) FIELD DEMONSTRATION PROGRAM, VOLUME 1 Interim Report No. 1, Sep. 1992 - Jun. 1993
ROGER ANDREWS, ROBERT BALTZER, ANDREW BOONE, LUCY GARCIA, and RICK GIER Dec. 1993 138 p
Contract(s)/Grant(s): F33615-92-C-5936)
(AD-A286426; REPT-63819-93U/P60099-VOL-1; AL/CF-TR-1994-0077-VOL-1) Avail: CASI HC A07/MF A02

This is Volume 1 of Interim Technical Report No. 1 for the Crew-Centered Cockpit Design (CCCD) Field Demonstration Program. Volume 1 discusses technical accomplishments and results. Volume 2 contains supplementary material in the form of twelve

appendices. The objectives of the CCCD Field Demonstration Program are to upgrade, validate, and transition a new system for cockpit design. The system consists of a crew-centered system design process (CSDP) and a set of computer-aided tools known as the Cockpit Design System (CDS). This report summarizes accomplishments during the period September 1992 through June 1993 that include: development of an improved CSDP; system support and management; design of new tools to manage and trace design progress; conversion and improvements to existing software tools; and restructuring of real-time simulation software. The progress on the first of five field demonstrations, known as the F-16 reconnaissance mission, is described and includes information on planning, crew system analysis tasks, prototyping of design alternatives, and reconfiguration of the real-time simulator. DTIC

N95-21637# Lawrence Livermore National Lab., Livermore, CA.
ERGONOMIC EVALUATION OF THE APPLE ADJUSTABLE KEYBOARD
P. TITTIRANONDA, S. BURASTERO, M. SHIH, and D. REMPEL (California Univ., Richmond, CA.) May 1994 4 p Presented at the International Ergonomics Association Workshop, Toronto, Ontario, 15-19 Aug. 1994
(Contract(s)/Grant(s): W-7405-ENG-48)
(DE95-002393; UCRL-JC-117548; CONF-940876-2) Avail: CASI HC A01/MF A01

This study presents an evaluation of the Apple Adjustable Keyboard based on subjective preference and observed joint angles during typing. Thirty five keyboard users were asked to use the Apple adjustable keyboard for 7-14 days and rate the various characteristics of the keyboard. Our findings suggest that the most preferred opening angles range from 11-20 deg. The mean ulnar deviation on the Apple Adjustable keyboard is 11 deg, compared to 16 deg on the standard keyboard. The mean extension was decreased from 24 deg to 16 deg when using the adjustable keyboard. When asked to subjectively rate the adjustable keyboard in comparison to the standard, the average subject felt that the Apple Adjustable Keyboard was more comfortable and easier to use than the standard flat keyboard. DOE

N95-21691# CHI Systems, Inc., Spring House, PA.
THE ADVANCED TECHNOLOGY CREW STATION: DEVELOPMENT AND VALIDATION OF A WORKLOAD ASSESSMENT TECHNIQUE FOR COCKPIT FUNCTION ALLOCATION Final Report
FLOYD GLENN, JAMES BOARDWAY, ROBERT WHERRY, JR., DAVID COHEN, and MEGHAN CARMODY 30 Jul. 1993 58 p
(Contract(s)/Grant(s): N62269-90-D-0110)
(AD-A279544; NAWCADWAR-93073-60) Avail: CASI HC A04/MF A01

The design of a new severely upgraded aircraft cockpit requires many design decisions to be made, at least tentatively, prior to any opportunities for generation of detailed design specifications and experimentation with prototypes. In considering issues of interface design and function allocation, it is important to develop predictions concerning the effects of the various design alternatives on pilot performance. Task network models and workload estimation techniques are typically used jointly to accomplish this goal. The work described here was conducted in order to refine type of analysis and prediction technique as part of the U.S. Navy's Advanced Tactical Cockpit (ATC) Pilot-Vehicle Interface (PVI) Program. DTIC

N95-21700 Southampton Univ. (England). Inst. of Sound and Vibration Research.
EFFECT OF LAGS ON HUMAN PERFORMANCE WITH HEAD-COUPLED SIMULATORS Final Report, 1 Jul. - 30 Nov. 1992
R. H. SO and M. J. GRIFFIN Jun. 1993 90 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(Contract(s)/Grant(s): AF PROJ. 7184)
(AD-A279577; ISVR-92/33; AL/CF-TR-1993-0101) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

This report reviews factors contributing to the effects of lags in head-coupled systems. A model of head tracking behavior is defined with appropriate feedback loops. The relevant lags and their possible effects on operator performance are defined. Twenty-one head-coupled simulators and operational head-coupled airborne systems are listed and grouped according to their feedback loops. Studies of the effects of lags within individual feedback loops are reviewed. The feedback loops investigated were the head-coupled visual loop, the head-slaved weapon control loop, the manual control loop, the eye-coupled visual loop, and the eye-slaved weapon control loop. The effects of relevant task and simulator variables, such as target velocity and motion cues are also discussed. DTIC

N95-21721# Sandia National Labs., Albuquerque, NM.
TOP TEN LIST OF USER-HOSTILE INTERFACE DESIGN
D. P. MILLER 1994 31 p Presented at the 41st Annual American *Vacuum Society Symposium, Denver, CO, 24-28 Oct. 1994*
(Contract(s)/Grant(s): DE-AC04-94AL-85000)
(DE95-001602; SAND-94-2548C; CONF-941001-2) Avail: CASI HC A03/MF A01

This report describes ten of the most frequent ergonomic problems found in human-computer interfaces (HCI's) associated with complex industrial machines. In contrast with being thought of as 'user friendly,' many of these machines are seen as exhibiting 'user-hostile' attributes by the author. The historical lack of consistent application of ergonomic principles in the HCI's has led to a breed of very sophisticated, complex manufacturing equipment that few people can operate without extensive orientation, training, or experience. This design oversight has produced the need for extensive training programs and help documentation, unnecessary machine downtime, and reduced productivity resulting from operator stress and confusion. Ergonomic considerations affect industrial machines in at least three important areas: (1) the physical package including CRT and keyboard, maintenance access areas, and dedicated hardware selection, layout, and labeling; (2) the software by which the user interacts with the computer that controls the equipment; and (3) the supporting documentation. DOE

N95-21866*# Tulane Univ., New Orleans, LA. Dept. of Mechanical Engineering.
A METHOD TO DETERMINE THE KINEMATICS OF THE LOWER LIMBS OF A SUBJECT PEDALING A BICYCLE USING ENCODERS AND ACCELEROMETERS M.S. Thesis
SHIH-CHING LIU 1 Apr. 1994 68 p Sponsored by NASA and the American Association of Engineering Education
(NASA-CR-197401; NAS 1.26:197401) Avail: CASI HC A04/MF A01

The goal of this research was to determine kinematic parameters of the lower limbs of a subject pedaling a bicycle. An existing measurement system was used as the basis to develop the model to determine position and acceleration of the limbs. The system consists of an ergometer instrumented to provide position of the pedal (foot), accelerometers to be attached to the lower limbs to measure accelerations, a recorder used for filtering, and a computer instrumented with an A/D board and a decoder board. The system is designed to read and record data from accelerometers and encoders. Software has been developed for data collection, analysis and presentation. Based on the measurement system, a two dimensional analytical model has been developed to determine configuration (position, orientation) and kinematics (velocities, accelerations). The model has been implemented in software and verified by simulation. An error analysis to determine the system's accuracy shows that the expected error is well within the specifications of practical applications. When the physical hardware is completed, NASA researchers hope to use the system developed to determine forces exerted by muscles and forces at articulations. This data will be useful in the development of countermeasures to minimize bone loss experienced by astronauts in microgravity conditions. Author

N95-22045# Army Aeromedical Research Lab., Fort Rucker, AL.
TEMPORARY THRESHOLD SHIFTS PRODUCED BY HIGH INTENSITY FREEFIELD IMPULSE NOISE IN HUMANS WEARING HEARING PROTECTION
JAMES H. PATTERSON, JR. and DANIEL L. JOHNSON Aug. 1994 28 p
(Contract(s)/Grant(s): DA PROJ. 301-62787-A-878)
(AD-A286289; USAARL-94-46) Avail: CASI HC A03/MF A01

Exposure to high intensity impulse noise produced by modern military weapons is known to be hazardous to hearing. Hearing protection is required; however, there is no generally accepted theoretical way to predict whether protection will be adequate for the highest noise levels. This had led us to empirically determine the safe limits of exposure to impulse noise when hearing protection is used by exposing human volunteers under controlled conditions. Over the past 5 years, a series of studies has been conducted to determine the maximum safe exposure to high intensity freefield impulse noise. An exposure was considered to be safe if it produced only a small temporary threshold shift (TTS less than 25 dB) in a small percentage of the volunteers exposed. Three different impulses were used with A-durations of 0.8, 1.4, and 2.9 ms. Both the level and number of impulses were varied to find the maximum tolerable exposure for combinations of these parameters. The peak sound pressure levels ranged up to 196 dB. The number of impulses was varied from 6 to 100. Approximately 60 volunteers were exposed to each type of impulse, allowing high confidence estimates of the exposures which would produce no significant TTS in 95 percent of the exposed population. The hearing protection used was an ear muff which had been modified to simulate a poor fitting protector. The results of these studies indicated that even with a relatively poor hearing protector, combinations of level and number of impulses which far exceed our currently accepted exposure limits could be tolerated by 95 percent of the volunteers. DTIC

N95-22099# Department of the Navy, Washington, DC.
OCCUPANT REACH AND MOBILITY APPARATUS Patent Application
GARY R. WHITMAN, inventor (to Navy) and DAVID A. ROSE, inventor (to Navy) 12 Apr. 1994 12 p
(AD-D016253; US-PATENT-APPL-SN-226517) Avail: CASI HC A03/MF A01

A three-dimensional grid is created by a series of panels arranged in a semi-circle about a seated subject. The panels are configured or otherwise arranged to allow the seated subject full range of reach in all directions. The subject may be seated or standing and is placed a distance from the panels. The panels include a plurality of rods which slideably project through the panels in the direction of the seated subject. To determine reach, the subject reaches toward the rods and pushes them with either hand as far away from him/her as possible. Measurements may then be taken from the end of each rod that has been moved. Similarly situated panels, including visual indicia, may be used to evaluate field of view. DTIC

N95-22274# Army Natick Labs., MA.
PERSONAL HYGIENE BODY WIPE Final Report, 1 Oct. 1993 - 30 Sep. 1994
EDMUND M. POWERS and MARK J. BULLER Nov. 1994 71 p
(AD-A286092; NATICK/TR-95/002) Avail: CASI HC A04/MF A01

Military doctrine requires a soldier to take a shower at least once every seven days to maintain certain health standards. The objective of the PHBW is to provide the soldier with a temporary means of maintaining personal hygiene and sanitation when water/showers are not available. The PHBW will improve personal hygiene, morale and quality of life of the soldier in the field when water is not available. Statistically designed technical user tests of several typical commercially available wipes were conducted. The wipe selected as the most suitable for the soldier was one of the most effective soil removers, the most cost effective and was readily available from commercial sources. The formulation in the wipe is used on babies and is alcohol free and hypo-allergenic. Ingredients include cocoamphodi-acetate, aloe gel, lanolin, water, propylene glycol, preservatives and an adult fragrance. Toxicity clearance was granted by the Army Materiel Command Surgeon. The size of the wipes will be at least 7.2 x 8.5 and will be packed 12 wipes per package. A resealable label will allow removal of one wipe at a time. The PHBW will be managed by the General Service Agency and will be issued through the Class I distribution system. It will be regulated by revised Commercial Item Description A-A-641B, Hand Cleaner, Body Wipe (Pre-moistened Paper Towelette in a Packet). DTIC

N95-22275# Indiana Univ., Bloomington, IN. Inst. for the Study of Human Capabilities.
ACTIVITIES OF THE INSTITUTE FOR THE STUDY OF HUMAN CAPABILITIES Final Technical Report, 1 Jun. 1990 - 31 May 1994
CHARLES S. WATSON 31 May 1994 124 p
(Contract(s)/Grant(s): AF-AFOSR-0215-90)
(AD-A286471; AFOSR-94-0721TR) Avail: CASI HC A06/MF A02

During the final year of the award we devoted considerable time to an evaluation of the Institute's activities during its first years of operation. A great deal has been accomplished, as described in this report and the annual reports that preceded it. It was recognized in our final evaluation of the Institute's accomplishments, however, that the central theme of 'human capabilities' too broad to accurately represent the range of research conducted by our associated investigators. There is a need to identify more precisely the specific practical area or areas of science to which our research is applicable. Partly as a result of consultation with one of our visiting scientists, Dr. Gilbert Ricard from Grumman Aircraft Corporation, we have elected to limit the Institute's future research focus to the subject of Human-Computer Interaction (HCI). DTIC

N95-22466# Sandia National Labs., Albuquerque, NM.
FUZZY CLUSTERING OF FACIAL FORM FOR PROTOTYPING ENVIRONMENTAL PROTECTION EQUIPMENT
D. G. ROBINSON (GRAM, Inc., Albuquerque, NM.) 1994 6 p Presented at the International Joint Conference of the North American Fuzzy Information Processing Society and the Industrial Fuzzy Control and Intelligent Systems Conference and the NASA Joint Workshop on Neural Networks and Fuzzy Logic, San Antonio
(Contract(s)/Grant(s): DE-AC04-94AL-85000)
(DE94-014657; SAND-94-1354C; CONF-941219-1) Avail: CASI HC A02/MF A01

Emphasis on the human-to-aircraft interface has magnified in importance as the performance envelope of today's aircraft has continued to expand. A major problem is that there has been a corresponding increase in the need for better fitting protection equipment and unfortunately it has become increasingly difficult for aircrew members to find equipment that will provide this level of fit. While protection equipment has, historically had poor fit characteristics, the issue has grown tremendously with the recent increase in the numbers of minorities and women. Fundamental to this problem are the archaic methods for sizing individual equipment and the methods for establishing a sizing system. This paper documents recent investigations by the author into developing new methods to overcome these problems. Research centered on the development of a new statistically based method for describing form and the application of fuzzy clustering using the new shape descriptors. A sizing system was developed from the application of the research; prototype masks were constructed and the hardware tested under flight conditions. DOE

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SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

A95-71120
DENSITY AND MORPHOLOGY OF IMPACT CRATERS ON TESSERA TERRAIN, VENUS
M. A. IVANOV Vernadsky Inst., Moscow, Russia and A. T. BASILEVSKY Brown Univ., Providence, RI, US Geophysical Research Letters (ISSN 0094-8276) vol. 20, no. 23 December 14, 1993 p. 2579-2582
(HTN-95-20760) Copyright

Densities of impact craters on tessera, which is complex ridged terrain of tectonic origin, and on the remainder of the planet, which is mostly volcanic plains, were studied using Magellan images for about 96% of the surface of Venus. The density of large (D greater than 16 km) impact craters on tessera is higher by a factor of about 1.4 than on the remainder of the planet. This means that the tessera crater retention age is larger than the age of the plains. This is in agreement with the well known fact that tessera is embayed by the surrounding volcanic plains. The density of small (D greater than 16 km) impact craters on tessera is lower than on the remainder of the planet, evidently an observational bias caused by a difficulty in recognizing the small craters on rough tessera terrain. The absence of recognizable tectonic deformation in most of the large on-tessera craters means that during the period of crater emplacement most of the studied tesserae were tectonically stable and did not undergo noticeable degree of deformation. Author (Herner)

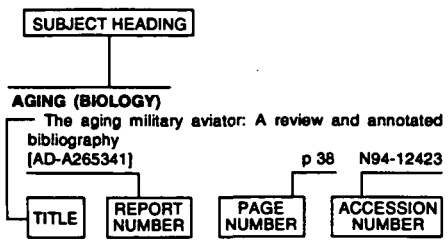
A95-71121* National Aeronautics and Space Administration, Washington, DC.
HIGHER ORDER STATISTICS OF PLANETARY GRAVITIES AND TOPOGRAPHIES
WILLIAM M. KAULA Univ. of California, Los Angeles, CA, US Geophysical Research Letters (ISSN 0094-8276) vol. 20, no. 23 December 14, 1993 p. 2583-2586
(Contract(s)/Grant(s): NAGW-2085; NAGW-2997)
(HTN-95-20761) Copyright

The statistical properties of Earth, Venus, Mars, Moon, and a 3-D mantle convection model are compared. The higher order properties are expressed by third and fourth moments: i.e., as mean products over equilateral triangles (defined as coskewance) and equilateral quadrangles (defined as coexance). For point values, all the fields of real planets have positive skewness, ranging from slightly above zero for Lunar gravity to 2.6 sigma(exp 3) for Martian gravity (sigma is rms magnitude). Six of the eight excesses are greater than Gaussian (3 sigma(exp 4)), ranging from 2.0 sigma(exp 4) for Earth topography to 18.6 sigma(exp 4), for Martian topography. The coskewances and coexances drop off to zero within 20 deg arc in most cases. The mantle convective model has zero skewness and excess slightly less than Gaussian, probably arising from viscosity variations being only radial. Author (Herner)

A95-71162* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
NEUTRAL COMPOSITION MEASUREMENTS BY THE PIONEER VENUS NEUTRAL MASS SPECTROMETER DURING ORBITER RE-ENTRY
W. T. KASPRZAK NASA. Goddard Space Flight Center, Greenbelt, MD, US, H. B. NIEMANN NASA. Goddard Space Flight Center, Greenbelt, MD, US, A. E. HEDIN NASA. Goddard Space Flight Center, Greenbelt, MD, US, S. W. BOUGHER Univ. of Arizona, Tucson, AZ, US, and D. M. HUNTEN Univ. of Arizona, Tucson, AZ, US Geophysical Research Letters (ISSN 0094-8276) vol. 20, no. 23 December 14, 1993 p. 2747-2750
(HTN-95-20802) Copyright

Measurements by the Pioneer Venus Orbiter Neutral Mass Spectrometer (ONMS) instrument during Orbiter re-entry have been made from 18-24 hours local solar time, above 170 km, of He, and from midnight to 4.5 hours below 200 km of He, N, O, CO, N2, and CO2. Preliminary results indicate that in the post-midnight sector He is the dominant species above 170 km, O the dominant species from 140-170 km and CO2 the dominant species below 140 km. Estimated scale height temperatures for He, O, and CO2 of about 105-120 K are similar to those observed in 1978-1980 at higher solar activity. The densities at 1 am local solar time and at 150 km are within 35% of those measured earlier. The He bulge is also similar to that observed in 1978-1980 confirming that thermosphere superrotation is still present. Comparison with the results of a Venus Thermosphere General Circulation Model suggests the nightside is not sensitive to changes in solar activity due to the isolation of the day and night thermospheres. apparently, the relatively small changes in the dayside thermosphere with solar activity have little impact on the nightside thermosphere. Author (Herner)

Typical Subject Index Listing



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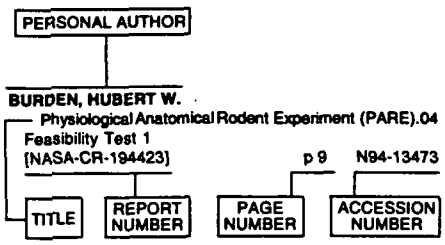

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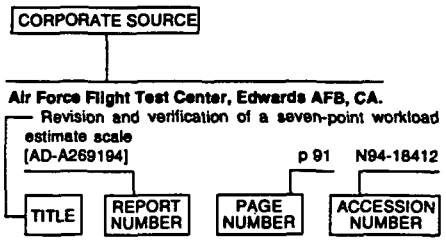

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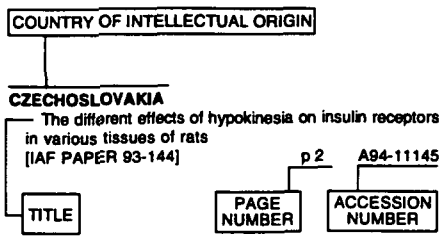

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CONTRACT NUMBER INDEX

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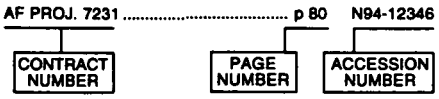

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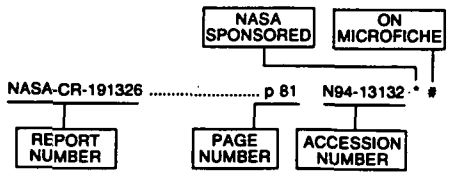
Typical Report Number Index Listing



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ACCESSION NUMBER INDEX

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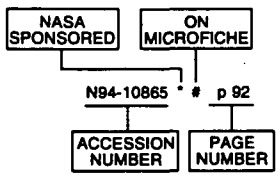

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